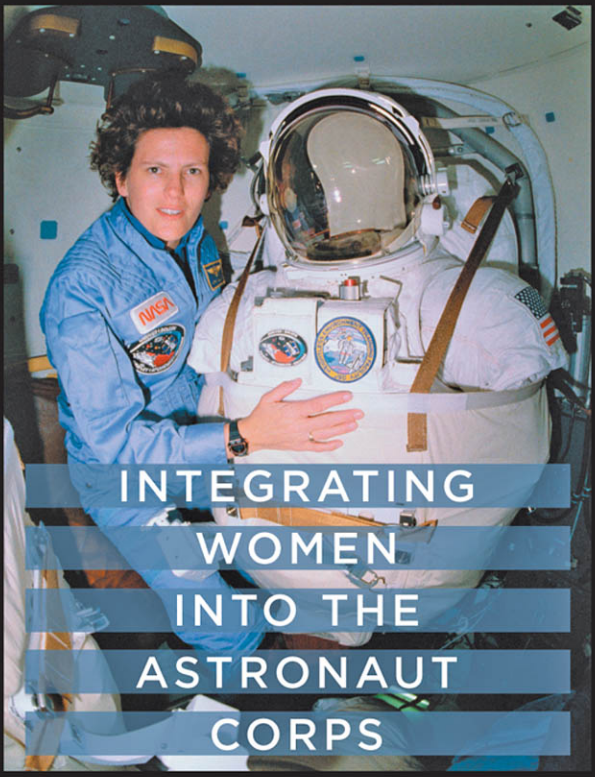
AMY E. FOSTER



INTEGRATING WOMEN INTO THE ASTRONAUT CORPS

POLITICS AND LOGISTICS AT NASA, 1972–2004

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Integrating Women into the Astronaut Corps

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Integrating Women into the Astronaut Corps

Politics and Logistics at NASA, 1972–2004

Amy E. Foster

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Acknowledgments

As a child and young adult, I wanted to be an astronaut. I grew up during the Shuttle era and watched intently each Shuttle launch on television that I could. I plastered my bedroom wall, not with posters of teen idols or pop stars, but with pictures of launches and newspaper articles about women astronauts of the 1980s. I took special pleasure that the first launch of an American woman occurred on my birthday. So when my career path took me away from aeronautical and astronautical engineering (my vision of what NASA was looking for in the class of astronauts that would include me) and into the history of technology, studying the Shuttle program and what it meant for women astronauts seemed like a project destined just for me.

This has not necessarily been an easy book to research. While the NASA History Office in Washington, D.C., maintains a growing archival collection on women in space, getting at the technological details involved in designing a vehicle for mixed-sex crews and uncovering the social and political aspects of the integration process required some creativity in research and a dependence on oral histories. I wish to thank all those archivists who thought of resources that I never would have explored without their knowledge and insight into their collections: Anna Peebler and Shelly Kelly at the University of Houston–Clear Lake archives; Amy Rupert at the Renssellaer Polytechnic Institute archives in Troy, New York; Colin Friese and Jane Odom at the NASA Headquarters History Office; and the staff at the National Archives and Records Association–Southwest in Fort Worth, Texas. I am grateful for all your help.

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Finally, to the female astronauts, who were my research subject, and all the NASA employees who willingly shared their stories with me, thank you! Your legacy is our reward.

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Integrating Women into the Astronaut Corps

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Introduction

It was a hot Sunday morning in July, a typical summer morning in Houston, Texas. It was the kind of morning best spent relaxing and keeping cool, particularly if one were nine months pregnant. But today she was up on a stepladder, reaching for items on the top shelf of the kitchen cabinet. After all, she and her husband were moving into their new home soon and they still needed to pack up their household goods. She intended to work for only a few hours because the hospital was expecting the couple for a visit to the maternity and delivery wards that afternoon at one o'clock. But around 10:00, as she worked, a rising feeling of discomfort overcame her. The packing would have to wait.[1]

Even though this was her first child, she knew relatively quickly that she was in labor. As a medical doctor, she certainly knew what to look for when identifying contractions, but the growing regularity and consistency of the pains confirmed that her baby was coming. Her husband, a military pilot, had gone to the airport that morning to get some work done. He knew about the hospital visit that afternoon and was bound to be home in time to make their appointment. With her husband half an hour away and relatively out of contact, she could do little more than wait and time the contractions.

When her husband returned home, late of all days as she recalls, he found his wife lying on the floor with a stopwatch in her hand. He said, "Oh, good. We're not going to be late to our hospital visit!" By then the contractions were about five minutes apart. She knew it was still early labor, but now was as good a time as any to head to the hospital.

She labored all day and into the night with her first child. In the early morning hours, however, the baby started to show signs of distress. Doctors finally delivered the baby by emergency Cesarean section around four in the morning. Infant Paul, who was not yet breathing, was rushed out of the room without his mother having a chance to see him. But she knew that the

pediatrician needed to take care of him right away. Before the baby was even eight hours old, he was flown by helicopter to Hermann Children's Hospital's neonatal intensive care unit. After four days of recovery on her own, Paul's mother joined him at Hermann until he was ready to go home.

Granted, modern medical practices and technology had aided significantly in the birth of this particular child. But generally, his mother had done the same thing that billions of women had done before her. However, people did not see this as just any standard birth. This was not a typical baby and his parents, Rhea Seddon and Robert "Hoot" Gibson, were not typical parents. Paul Seddon Gibson, born on July 26, 1982, was the world's first "astrotot"—the first baby ever born to two astronauts. Rhea Seddon also became the first astronaut ever to give birth.[2]

When the National Aeronautics and Space Administration selected the first women as astronaut candidates in 1978, people working at NASA probably thought they were fairly well prepared to have women in the astronaut corps. Early in the 1970s, NASA officials from the administrator down had emphasized that women would be a part of the astronaut corps, specifically beginning with the Space Shuttle program. NASA selected its first class of women astronauts as part of Group VIII, the eighth class of astronauts chosen since NASA's inception in 1958. They were Anna Fisher, Shannon Lucid, Judith Resnik, Sally Ride, Margaret Rhea Seddon, and Kathryn Sullivan. Although NASA hoped for a smooth process of integrating women and ethnic minority Americans into the astronaut corps, good intentions cannot always ease the stresses inherent in change. One issue that NASA engineers confronted was the challenge of designing equipment that both male and female astronauts could use. But a more important barrier to the success of integrating women as astronauts was that all employees at NASA, including the women astronauts, had to deal with the tensions inherent in the cultural biases against women in the workplace and against women challenging the iconographic image of the astronaut. This book follows both NASA's steps and those taken by the first women astronauts as American spaceflight was desegregated by sex. Documenting these events leads to a broader understanding of the difficulties that arise when a workplace is sexually integrated, even when the organization approaches the situation with a positive outlook and strong motivation, as NASA did.

The women who have served as astronauts represent a highly elite group of workers. NASA selects only an extremely small number of astronauts to be

members of any one class, particularly relative to the number of applicants. In that sense, becoming an astronaut compares to such fields as entertainment and professional sports in terms of competitiveness.[3] For that reason, using the astronaut corps as a case study for women's labor history appears problematic. But studying the sexual integration of America's astronaut corps provides a new perspective on the relationships between women and technology, management, and culture. Although becoming an astronaut is an elite career choice, the public nature of an astronaut's job duties gives historians of gender and technology and of women's professional history some insight into the struggles women commonly experienced when sexually integrating a workforce.

Past scholarship on women's labor history paid attention to how women's work moved beyond the home and into public spaces, and it focused on the segregation of women and men in the workplace, most often considering examples during World War II. These historians ask how sexually segregated working environments are constructed and maintained.[4] When institutions and organizations like NASA attempted to deconstruct that segregation, however, the cultural standards that first influenced the formation of gender hierarchy in the workplace did not simply disappear. In the narrow view, this book examines how an organization and individual women labored to create an integrated, equal working environment for both sexes in spite of cultural ideas and traditions. It focuses its attention on uncovering how cultural impressions of both the American space program and women's roles in society and the workplace influenced the process of integrating women into the astronaut corps. In the wider view, it will contribute to the next evolutionary stage of women's labor history and the history of gender and technology by examining how cultural ideas about the sexes and gender, along with technological and political concerns, complicate the inclusion of women astronauts at NASA. This project moves the study of women in the workforce beyond asking "Where are the women?" and "How did women get their feet in the door?" It uncovers the complexities of inequality in the workplace and why they exist.

Historically, workplace integration often appears as something dictated by circumstance or by law as in World War II and the Civil Rights Act of 1964. But often when an outside force is responsible for the entrance of underrepresented workers, industries resist and the workers are left struggling to carve out their own places. In the case of the NASA astronaut corps, federal

dictates came into play when Congress passed the Equal Employment Opportunity Act of 1972. NASA actually had already engaged in hiring and encouraging female and ethnic minority employment before federal law demanded such actions. In any case, one analytical line in this story focuses on how NASA as employer confronted the idea of sex (the biological differences between male and female bodies) and gender (the cultural expectations of behavior for those sexes) in the workplace.

The experiences of the six women selected as astronaut candidates in 1978 make up a second analytical perspective. However, the fact that they are women adds a third dimension of analysis—an engineering analysis of hardware. While engineers must take human factors into consideration when designing a workplace—for example, an assembly line needs to be accessible to workers of varying heights and arm lengths—workplace designers focus most of their attention on ways to improve efficiency.[5] But for a spacecraft, designing both mission-oriented and survival-oriented hardware and interfaces to fit astronauts of different sizes, sexes, and physical characteristics becomes a more complex challenge. The third analytical piece to this study examines how the integration of women into the astronaut corps affected Shuttle designs and procedures as well as ground-based operations.

The book's fourth and final area of analysis, the role that cultural ideals have played in the expansion of American spaceflight to include women, actually serves as an overarching theme, connecting the other three discussions. What the public believed was proper for men and women in a working relationship influenced how NASA, the women of Group VIII, and design engineers adapted to the changing astronaut corps. Much of America's space history, particularly with respect to women, is a reflection of public ideas about space travel and exploration. Historically, the issues that disturb the sexual integration of any workplace come down to questions of cultural propriety. Is it right to have men and women working next to each other? Does the act of hiring women undermine men's social responsibility to provide for their families? How do working women challenge the socially constructed male role as breadwinner? Does the work of women outside the home keep women from their caregiving duties? Does the work strain their moral character in a way that makes them unfit as mothers? Although such conservative questions diminished considerably thanks in part to the second women's movement, which began in 1963 with the publication of Betty Friedan's *The Feminine Mystique* and with the black civil rights movement,

the public still expressed a fair amount of concern over the sexual propriety of men and women flying together in space.[6] The cultural issues surrounding women in space must be addressed if the sexual integration of the astronaut corps is to serve as a case study of women's labor history.

This study strives to uncover not just the biographies and experiences of the first American women astronauts. At some level, others have already told those stories.[7] But those works all neglect to explore NASA's integration process. Instead, they discuss the history of NASA's exclusion of women from the astronaut corps in the 1960s or provide an encyclopedic treatment of women astronauts since 1978. This body of work focuses on the individual stories of the women. But those narratives lack an analytical treatment of their experiences in the context of technological and logistical challenges of integrating women into the astronaut corps, cultural ideas about women astronauts, and the larger historical narrative about women in the workplace, particularly a white-collar, technologically elite workplace. This book intends to address the technological and logistical history as yet unexplored and fill those analytical holes.

But this work does more than just satisfy a need in the literature in space history and the history of technology. It makes a larger contribution to women's history and labor history as well. While this story illustrates the integration process within NASA, it also explores how Americans viewed the idea of women as astronauts. The women who applied to the astronaut corps in the 1960s and were rejected, as well as the women who were selected in 1978, challenged American postwar ideals about women in the workplace. Yes, women had always worked. In that sense, the women astronauts and astronaut hopefuls were not breaking down barriers. What historians have studied most carefully is the labor history of working-class women.[8] But being an astronaut is not a working-class job; it is highly skilled, white-collar technological work. The women who applied to become astronauts came from middle-class backgrounds and had at least some college education. This story addresses the history of women in the professions.[9]

Because the women astronauts came from middle-class backgrounds, their stories differ from those of working-class women. Further, because they were middle class and trying to enter traditionally male jobs, they were violating two postwar middle-class mantras about women and work. First, middle-class Americans, men and women alike, viewed women not working for wages outside the home as a sign of status. If a woman worked outside the

home, it suggested that she was not yet married or that she and her husband had not yet started a family. The generation that shaped the postwar ideas about women's work grew up during the Great Depression. That economic crisis influenced their ideas about women's work outside the home. It was understandable if a woman needed to take on paid work to help make ends meet during the Depression. But it remained the husband and father's responsibility to provide for his family. For that reason, postwar Americans viewed marriage and homemaking for women as a sign of prosperity. As historian Elaine Tyler May explains, a married woman working outside the home *and* for wages following World War II—particularly beyond the birth of her first child—suggested that her husband was a failure. Women's employment further undermined the idea that work outside the home was "men's work," the second postwar middle-class mantra.[10]

The women who tried to become astronauts in the 1960s received much more criticism than the women of Group VIII. But neither was it a foregone conclusion across the United States in 1978 that America's first women astronauts would succeed, nor that they belonged in the astronaut corps. The 1960s case shines a light on the middle-class American ideals about women and work. But despite changing legislation in the 1970s about equal employment for women, still the first women astronauts met with scrutiny, criticism, and discriminatory remarks from people within NASA and the American public.

America's women astronauts participated in a professionalized, scientific, and technological workforce. At some level, America's Rosie the Riveter during World War II showed Americans that women could perform in technological fields (albeit blue-collar work). But employers identified the jobs filled by women to meet the national demand during World War II as temporary, vital work, thereby negating their contributions as workers. Even though women did the same jobs during the war that men typically performed in peacetime, circumstances allowed employers to differentiate Rosie the Riveter's performance and abilities from their male counterparts. Michael Katz, Mark Stern, and Jamie Fader cite that differentiation of work for men and women as the key to the "paradox of inequality," explained as "the coexistence of structural inequality with individual and group mobility."[11] This paradox of inequality explains why women continue to suffer pay inequality, find themselves excluded from job opportunities, and hit the glass ceiling in spite of laws protecting equality. Even though women showed they

could perform technological work during World War II, their experiences did little to redefine technological work as both male and female work.

Where the paradox of inequality becomes so important to women in the professions is in access to college educations in traditionally male areas. The paradox hampered women astronaut hopefuls further by restricting their access to graduate school and the pipeline careers that NASA's selection criteria demanded from their astronaut candidates. The women astronauts needed to prove their abilities in the classroom, by earning graduate degrees, and then again through their work as astronauts as a necessary step to redefining the image of "astronaut."

As a history of women in the professions, this work focuses on a smaller but growing proportion of women at work. What becomes apparent in a study such as this one is that the struggles in the history of women in the professions mirror those found in the history of women in the general workforce. But cultural ideas about class, and consequently race and marital status, complicate women's opportunities and perpetuate the paradox of inequality.

The history of American women as astronauts is relatively short. But it is a history that offers more than just a collection of fascinating stories. Embedded within the anecdotes about "astrotots" and space toilets are clues about why the sexual integration of a workforce, particularly a highly scientific and technical one, was so difficult. Less than a century ago, society considered it improper for a lady to show her ankle. With the birth of the Shuttle era, men and women were sharing intimate spaces and their personal lives. Further, the women astronauts were invading a traditionally male activity. By the 1970s, people had grown more comfortable with the idea that women could work outside the home. But integration still tended to clash with deep-seated beliefs and conventions about women's roles—and men's roles—in society. More than anything, this book is about how ineffectual Western society has been at coming to grips with sex, including intercourse, physical differences, sexual and gender identity, and sexual orientation. At a time when women were making positive strides in many different career fields, the politics and logistics of sexually integrating the astronaut corps highlight how difficult it is to change one's way of thinking. One consequence of those difficulties is that until our culture can adopt a "get over it" attitude about sex, we cannot become a true space-faring society.

CHAPTER 1

Beyond Rosie the Riveter

When NASA introduced the members of its Group XIX astronaut selection on May 6, 2004, the agency was also introducing a new kind of astronaut: the "educator mission specialist." For the first time, not every astronaut candidate had to possess a background in aviation, science (including medicine), or engineering. Further, NASA required that its educator mission specialists have a background in teaching, a career dominated by women in the twentieth century. But for women who tried to enter the astronaut corps through backgrounds in aviation, science, and engineering, they carried the extra burden of having to succeed in these male-dominated fields before they qualified even to apply for astronaut candidacy. When NASA selected its first female astronauts in 1978, these six women already had faced the challenges of being working women in a man's world. Just as culture and politics of the 1970s played a part in the selection of women astronauts in 1978, so too did these factors contribute to the expansion of women's opportunities in other male-dominated fields. This chapter outlines the history of women's efforts to gain access to these astronaut pipeline careers and the political events that influenced America's cultural willingness to accept women working in nontraditional professional fields.

Most Americans with a minimal knowledge of twentieth-century labor history know the story of Rosie the Riveter. The iconic woman with her arm flexed and wearing a red bandanna on her head graced recruitment posters during World War II as part of an effort to encourage women to take over the factory jobs left vacant by men headed off to war. Despite the large number of women who entered these nontraditional technical fields during the war, their successes did little to advance the opportunities for women entering the fields that would prepare them to qualify as astronauts. Certainly the women who worked as aircraft manufacturers as part of the war effort experienced their share of discrimination and intolerance for their part in breaking down

workplace gender barriers. But for women who wanted to study and practice science and engineering or who wanted to fly, their dreams required that they move beyond the historical and stereotypical characterization of Rosie the Riveter. Along with "Wendy the Welder," Rosie the Riveter encouraged young women to support their boyfriends and brothers overseas by joining the defense workforce and taking over where their men had left off.[1] But Rosie's "We Can Do It" slogan suggested neither that women should move into these jobs permanently nor that all jobs were open to women. For women in aviation, society questioned whether those who served as pilots in military aircraft during the war were keeping within the limits of what they could do. After the war, Americans were more likely to question what work outside the home women (particularly white, middle-class women) *should* do.[2]

Between the end of World War II and 1976, the year NASA openly began recruiting female astronauts, women struggled to solidify their positions in aviation careers. Women flew as barnstormers in the 1920s. During World War II, women served not only as production workers but also as ferry pilots, air traffic controllers, training and navigation instructors, and maintenance crews as part of military-sponsored programs such as the Women's Auxiliary Ferry Squadron (WAFS), the Women Airforce Service Pilots (WASPs), and the Women Accepted for Volunteer Emergency Service (WAVES).[3] But when the war ended, the military disbanded the women's organizations. Factory supervisors encouraged their female employees to return to their places in the home. As historian Deborah Douglas has noted, "It was generally expected in this postwar period that young men and women could finally resume their lives, establishing the households and families that had been delayed for several years."[4] Even though women had shown that they could do the physical tasks involved in constructing, maintaining, and flying airplanes, American society resisted justifying women staying on in those positions.

In the decades following World War II, a growing number of women took up flying as a hobby or as a job in general aviation—that is, nonmilitary aviation. Advocacy organizations and flying clubs for women, such as the Ninety-Nines (named for the number of charter members when the organization was established), Women Flyers of America (WFA), and the Women's National Aeronautical Association (WNAA), sponsored air races and worked to create an environment supportive of women who wanted to fly.[5] Even the Girl Scouts of America created a Wing Scouts program in 1945, which continued into the 1950s, to serve as an orientation for girls interested in becom-

ing pilots.[6] These groups were wonderful support systems for aspiring and established women pilots, giving them a chance to train and build up their logged flight time. But for those women who wanted serious careers as pilots, they had to push quite hard to get their foot in the door.

When World War II began, already some women were seasoned pilots. A handful of women started flying in the first decade following the 1903 Wright flights. As early as the 1920s women pilots helped to sell aviation to the general public. According to historian Joseph Corn, in this era when people with little or no exposure to airplanes saw a woman flying, they took it as a sign that flying must be easy and the technology was safe.[7] Recognized aviatrix and air racer Louise Thaden, who worked in sales for Travel Air Corporation, said, "Nothing impresses the safety of aviation on the public quite so much as to see a woman flying an airplane."[8] From the 1950s into the 1970s, even though Americans had been traveling by plane for decades, commercial aviation still used the presence of women on board to calm passengers' fears and concerns. Generally they hired women only as flight attendants, not as pilots. No major commercial airline employed a female pilot until 1973, when Frontier Airlines hired Emily Warner.[9]

Until Warner went to work for Frontier, few women found opportunities to fly in general aviation. Women like Geraldine "Jerrie" Cobb (born 1931), better known as one of the first women to undergo the medical testing given to the Mercury astronauts, forged their own opportunities. Cobb benefited in her pursuit of flying from her father's experience as a pilot. He even gave Cobb her first flying lesson. With additional lessons, she earned her private pilot's license on March 5, 1948, her seventeenth birthday.[10] Working part-time as a crop duster, a "general flunky" for other pilots, and a pilot-for-hire for an oil company, she earned enough money and flight time to get a job as a flight and ground instructor in 1952.[11] She earned her first job as a ferry pilot, her lifelong career, at Fleetway in Miami in 1953 largely by circumstance; her boss, Jack Ford, owned a fleet of T-6 aircraft needing to go to Peru with no other pilots available to fly them.[12]

Cobb and the few women like her created opportunities to work as pilots through their persistence, proof of competence, and excellent flying skills, along with a touch of serendipity. But as part of each astronaut selection since 1959, NASA demanded more of its pilot-astronaut candidates than just a pilot's license and a few thousand hours in a plane; they needed flight time in high-performance aircraft. Since NASA's creation in 1958, the best place to

get that kind of pilot experience had been the military. Generally Americans begrudgingly closed their eyes to women serving as pilots during World War II out of need. But for women to qualify as pilot-astronauts, they needed access to military aircraft. That required major cultural shifts regarding women in the military.

When the second women's movement—categorized by the fight for women's social and economic equality—began in the 1960s, the United States military was heatedly engaged in Vietnam. Given the unpopular nature of the war, women's rights organizations found fighting for the improvement of women's opportunities in the military a poor use of resources.[13] Further, the draft, reinstituted in 1967, had largely filled the military's need for pilots; the pressing need for women pilots that existed during World War II did not exist.

The cultural doubts about whether women should fly, along with the Women's Armed Services Act of 1948, which banned women from combat cockpits, protected all military aviation positions against the inclusion of women.[14] A few women such as Frances Biadosz did build great careers for themselves in the military, thanks in part to their WAFS and WAVES experiences during the war. But more often women needed to work harder and be more persistent to create real opportunities in military aviation than in general aviation.[15] The organization most responsible for early changes in the military's attitudes about women in nontraditional military jobs was the Defense Advisory Committee on Women in the Services (DACOWITS), the brainchild of General George C. Marshall.[16]

Originally formed by the military during the Korean War as a way to "assure the public that those [women] it needed were conforming to American conventions of feminine respectability," DACOWITS became one of the strongest advocacy groups for women's rights in the military.[17] The challenge for DACOWITS had nothing to do with presenting women as capable and talented contributors to the services' mission. The women themselves had proven that already through their service in previous wars. Even General Dwight Eisenhower, chief of staff of the U.S. Army in 1947, acknowledged women's contributions to the military and heartily supported the bill to integrate women into the regular army and the reserve corps.[18] The real challenges facing DACOWITS rested in overcoming the *gender* barriers in the military, not sexual barriers. As Linda Bird Francke argues, "The combat issue was never about women but about men. The legal imperative seemed to

be to preserve male privilege."[19] Ultimately the committee held the same debate when it met for its spring conference in 1991. Air force captain Anne McGee commented then that "the hierarchy in the Navy is all designed for the folks who are in charge of ships. In the Air Force, it's the guys who fly fighters. The navy lets women fly fighters, but not be in charge of their boats because that is where their power is. The Air Force power base comes from flying fighters, so women aren't allowed to fly them."[20]

Even though DACOWITS understood the difficulty in pushing for women's rights in the military during the Vietnam era when the war was so unpopular among many Americans, that unpopularity actually worked to the advantage of women. After World War II, the military continued to accept women, but in limited numbers. When Congress reinitiated the draft, DACOWITS used the military's need for recruits as an opportunity to lobby for raising the recruitment ceilings for women. In November 1967, the committee successfully lobbied Congress to pass Public Law 90-130, which eliminated both the cap on the number of women in the armed services and the restriction on female officer promotions above the rank of colonel (captain, in the navy).[21]

Public Law 90-130 certainly opened up more leadership positions, and the armed services generally, to a greater number of women. But it was the end of the U.S. presence in Vietnam that cultivated a more conducive environment for DACOWITS to orchestrate sweeping changes. In 1973, when the military became an all-volunteer force, recruiters confronted growing concerns about their abilities to meet the demands for people. Simultaneously, Congress was debating the Equal Rights Amendment (ERA), of which some of the conversations focused on the role of women in the armed services. Unlike the civil rights and feminist groups, who pushed for the expansion of military opportunities for women from outside of military circles, DACOWITS was "the preeminent 'D[epartment] O[f] D[efense]' actor."[22] That political status gave the committee access to senior defense department officials and Congress. The prospect of Congress approving ERA and the work done by DACOWITS led Admiral Elmo Zumwalt, the chief of naval operations, to open naval flight training to women in January 1973.[23] The army followed suit with its first female aviator reporting to flight school in September 1973.[24] Even then, however, the women could only fly helicopters and prop aircraft, not jets.

Unfortunately, DACOWITS and feminist advocates of women's equal treatment in the military were fighting more than just the existing cultural mores

against women serving in combat roles. The technology itself proved exclusionary. In her 1997 article "Manufacturing Gender in Commercial and Military Cockpit Design," Rachel N. Weber discussed how the gender biases that creep into cockpit engineering result in the exclusion of many women pilots, consequently influencing social ideas about women in flight. She wrote, "Although technology certainly is not the only 'cause' of exclusion and segregation, biased aircraft act as symbolic markers, used to delineate the boundaries between men's and women's social space."[25] Translation: if women do not fit into the cockpit, obviously they do not belong there.

Ergonomics and the study of human factors as disciplines developed during World War II and had a decided impact on the way engineers approached the questions of cockpit design. It was not until 1988, however, that the U.S. Army Natick Research Development and Engineering Center compiled a database of physical dimensions for designers as a tool to help standardize their designs.[26] For military applications, contractors agreed to build their aircraft with cockpits that accommodated the middle 90 percent of pilots, thereby excluding the bottom and top 5 percent of the sample.

Using that database to determine the specifications of a given cockpit, however, investigators uncovered thirteen different parameters that might influence a pilot's interface with the hardware. For example, a person might have long legs but a short torso, making it difficult to reach controls on the ceiling. Weber commented that if cockpits met the middle-90th percentile specification for each of the thirteen different parameters, it would exclude 52 percent of current naval aviators.[27] More so, with cockpits designed for a thirty-four-inch minimum sitting height requirement (the height that accommodated the middle 90% of men), only 30 percent of female aviators met the requirement.

Engineers generally do not discuss the merits of sexual equality when designing an aircraft. Weber acknowledged that contemporary political mandates regarding women in combat positions fueled the efforts to "gender-neutralize" military aircraft.[28] But the mission considerations for a military cockpit complicated those measures. High-performance military aircraft accelerate at high rates of speed, requiring elaborate restraint systems, and must be equipped with effective ejection seats. Recent discoveries of the dangers of automobile airbag deployments to children and smaller adults illustrate the significance of a person's size when it comes to a given technology's effectiveness at protecting the human body.[29] The airbag issue shows that designing

one-size-fits-all safety devices is difficult, even on the ground. But under the extreme conditions a military pilot experiences as a consequence of the aircraft's performance requirements, designing a cockpit that can meet the needs of all male and female pilots grows exponentially more complicated.

In the case of military aviation, the technical artifact itself helped to delineate women as "other" and added to the difficulties women faced in gaining access.[30]

When Secretary of the Air Force John McLucas finally announced that women would begin to train as pilots in the fall of 1976, it gave women the opportunity to fly jets and then serve as instructors in the same.[31] The air force's power base rests in its jets, particularly fighters. With American cultural ideas being against women serving in combat roles (and for the air force, those combat positions are in fighter jets), one of the last military arenas to sexually integrate was the air force pilot corps. But when the air force did finally open pilot training to women, they became pilots of the fastest, most powerful aircraft that any American woman had ever flown.

McLucas's decision to open pilot training to air force women only intensified the fight for women's equality in the military, as the laws against women in combat would not be revised until 1993. But for women who desired careers as pilot-astronauts for NASA, the policy change meant that women finally had similar access to jet aircraft experience as the male pilot-astronaut hopefuls. America's first female Space Shuttle pilot and commander, Eileen Collins, benefited from McLucas's decision. She was named to the second class to enter the Air Force Undergraduate Pilot Training Program that included women.[32] The navy finally permitted women, up to five every year, to fly jet aircraft in 1981.[33] With the inclusion of women in the military test pilot schools—the navy in 1982 and the air force welcoming its first female pilot to test pilot school in 1988—the last bastion to military training for women pilot-astronaut hopefuls fell.[34] Americans still have not resolved completely the issues of women flying jet fighters in combat. But by the 1980s, as a pipeline for women astronauts, the military had opened enough doors to give women a reasonably competitive chance in the selection of future astronauts.

Like pilot-astronauts, mission specialists bring extensive skills and training to NASA. Beginning with the scientist-astronaut selections for the Apollo program in 1965, NASA wanted its candidates to have doctoral-level work in science, medicine, or engineering or equivalent work experience.[35] So the opportunity for women to break into these fields carried great importance for

the future of women astronauts. But as noted by historian Margaret Rossiter, "Although by all accounts the period 1940–1972 was a golden age for science in America, it has generally been considered a very dark age for women in the professions."[36]

The women who chose to enter science and engineering after World War II had even less tradition and national support than women in aviation had.[37] Compared to the number of women working in aircraft factories (blue-collar work) and as pilots (white-collar work), relatively few women were recruited during the war as scientists and engineers to replace men leaving their positions for wartime duty.[38] In the cases where women were recruited, it was clear that their positions, often as engineering aides or junior engineers in the aircraft industry, were temporary.[39] Unlike in military aviation, women in science and engineering during the war did not inspire the same kind of public interest as the women who served as WASP and WAVES, and they did not become the subject of national media attention.[40] The successful experiences of women pilots during the war gave future women aviators some foundation on which to build. Although women working as scientists and engineers during the war—some in efforts as prestigious as the program to develop penicillin and the Manhattan Project—proved they were able to perform in those jobs, their relative obscurity only perpetuated women's postwar struggles to establish themselves in the sciences and engineering.[41] Future female scientists and engineers simply did not have that same sense of history or national recognition coming out of the war.

When NASA began recruiting scientist-astronauts in early 1964, the pool of scientists and engineers with doctoral-level work was small, and the number of women in that pool comparatively nonexistent. In the 1950s American universities awarded 53,000 science and engineering PhDs, but women earned only 3,500. By the 1960s there were 105,000 PhDs, with just 7 percent of them women.[42] Just as the women pilots experienced after the war, there was a general feeling in America (given the prosperity the nation witnessed in the postwar 1940s and the 1950s) that women scientists and engineers should return to the home and men alone should provide for their families. Not only were political leaders, such as Richard Nixon, extolling women's place in the home, but the GI bill permitted returning veterans to flood the universities and eventually the job market, making it more difficult for women to enter the scientific and engineering workforce.[43] Even employees who traditionally hired women scientists, such as women's colleges, teaching colleges, and

schools of home economics, quit hiring women and moved to replace women professors with men.[44] As Margaret Rossiter argues, "Women's wartime accomplishments, rather than justifying an increased role for women in the postwar world, were quickly forgotten."[45]

For those women who did continue to work in the sciences and engineering after the war, the long-standing idea that women should be home to raise their children translated into the belief in the 1950s and 1960s that women would only work for a few years before they would leave the company to get married and start a family, much like the early twentieth-century standards preached to, and for, young women.[46] Some women succumbed to the notion that women should leave the science and engineering work to men. Census numbers from 1960 show a drop in women's participation in these fields.[47] But given the increased encouragement for middle-class women to return to their homes, just like the television character June Cleaver and those played by June Allyson, a shift away from the workplace and back to the home during the 1950s comes as no surprise. By and large women moved into traditionally male jobs only in limited numbers in the 1950s. The significant fight for access into new fields had to wait for the beginning of the second women's movement in 1963.

Like DACOWITS for women in aviation, women in science and engineering needed a push to help ease the transition into their disciplines. The early phases of the Cold War helped somewhat.[48] But the most important push prior to the rise of feminism was the Soviet Union's launch of *Sputnik*, the planet's first artificial satellite, on October 4, 1957. Americans were concerned that if the Soviets could launch a satellite, they might also be able to launch a nuclear weapon on the United States. They assumed that the Soviets had an educational and technological advantage over the United States and that the situation must be remedied. The U.S. Department of Education agreed, stating that "in today's perilous world, to fail to invest enough of our expanding resources to support education on the scale that is necessary could be tragic."[49] Even President Dwight Eisenhower responded to the public concern by organizing the Presidential Science Advisory Committee (PSAC), bringing together "the very best thought and advice that the scientific community can supply . . . so that no gap may occur."[50]

Schools around the nation adopted a newly charged focus to revamp science and technology education in hopes that more young people would choose these majors to study in college and pursue as careers in the work-

force. Further, the National Defense Education Act, passed in August 1958, provided loans and scholarships for academically qualified students interested in studying mathematics, science, engineering, and modern foreign languages. These changes aided women's efforts to enter into these fields that had been deemed appropriate only for men after the war. In fact, a number of women, including those who either entered NASA's astronaut corps or worked at NASA in a support capacity, credited *Sputnik*'s impact on the American education system as one of the factors behind their decisions and opportunities to study science and engineering.[51]

Sputnik, in an indirect way, thus made it possible for more women than ever before in American history to get an education in the sciences and technology. That education would be essential to women's ability to qualify for selection in the astronaut corps. But access to such an education did not necessarily translate into open opportunities in the workforce. When the *New York Times* published advertisements for aerospace engineers and scientists in its October 9, 1961, classified ads, all the column headings for these job listings read, "Help Wanted—Male."[52] Nor did the national emergency grant access to all disciplines of science and engineering. According to the National Science Foundation's report on American scientific manpower, between 1956 and 1958 the five scientific subfields with the highest percentage of women employed full-time were developmental psychology (45.59%), other biological specialties (35.10%), educational and school psychology (29.39%), nutrition and metabolism (23.60%), and clinical psychology (22.81%).[53] Whether men were consciously channeling women into those fields or women were deciding on those fields for themselves, it remains that women leaned more toward jobs in the "softer" sciences—that is, those areas associated more with life and nurturing—than the hard sciences, such as physics and engineering. More opportunities for an education in the sciences may have opened for women on account of *Sputnik*, but employment still seemed to be affected largely by cultural ideas about women and work.

Shannon Lucid (née Wells), at 35 years of age, was the oldest woman selected by NASA in 1978 as part of the first class of astronauts to include women. When *Sputnik* was launched, she was already a sophomore in high school and had a clear desire to study science in college. The new focus on science and engineering education in the United States did, however, create fellowship opportunities for Lucid and other women that she acknowledges might not have been available without the events surrounding *Sputnik*.[54] But

it did not create jobs for women directly. Just weeks away from graduation with her bachelor's degree in chemistry, Lucid approached one of her professors to ask how to find a job. He replied to her, "Miss Wells, you are not going to get a job because you are a woman. You just need to go home and get married."[55] It was not the answer she expected or wanted to hear. But he was largely correct, as jobs for women in science were not very common. So, with her degree in hand, Lucid took a job changing bedpans at a nursing home. When she did finally accept a position in her field, Lucid was hired as a temporary replacement for a male employee away on a year-long sabbatical.[56]

To earn credibility in a technical discipline, as Margaret Rossiter writes, women often had to return to school for a graduate degree, whereas men did not: "Any woman who might have held these same jobs may have needed a master's degree to be considered a scientist."[57] This seemed to be true for Shannon Lucid. After several years of working in temporary, part-time, underemployed, and often underpaid positions, she finally decided to pursue her master's and doctoral degrees in biochemistry at the University of Oklahoma. Ultimately, after graduate school, Lucid got a position as a research associate with the Oklahoma Medical Research Foundation, which she held until NASA selected her as an astronaut in 1978.

The advice that Shannon Lucid's college professor gave her as she neared graduation no doubt stemmed from a belief that permeated American culture both before and after *Sputnik*. As Congress discussed increased funding for science and fellowship programs in the wake of *Sputnik*, the *Wall Street Journal* published articles with such titles as "Science Talent Hunt Faces Stiff Obstacle: 'Feminine Fallout'" and "Officials Fear Many Federal Scholarships Will Go to Girls—Who'll Shun Careers."[58] Whether women would have left their jobs in droves or would have decided not to pursue a career after graduation is difficult to know simply because most employers chose to hire men instead of run the risk that women would leave the job shortly after hiring them. This concern about women workers persisted to some degree at NASA into the 1980s. When astronaut Rhea Seddon announced in 1981 that she was pregnant with her first child, she recalled one member of the Shuttle management team giving her a momentary look of panic before congratulating her. Seddon assumed that for an instant the man saw the impending loss of a Shuttle astronaut without her ever completing one flight.[59]

The larger consequence of the belief that women would decide not to

work after they married—a stance grounded in American labor practices for women in the early nineteenth century, when Francis Cabot Lowell hired young women to work in his textile mills until they married, and reaffirmed for middle-class women in the post–World War II era—was that women struggled hard to find work even into the 1970s. The National Science Foundation published employment numbers for men and women in the sciences for 1956–58 and for 1970. The number of women employed did rise between those years from 8,654 to 25,609, but the percentage of women who found jobs in industry, typically the most lucrative sector of the job market, dropped from 24 percent to 14 percent. The majority of women working in the sciences were employed at universities, while the rest worked in government or nonprofit organizations.[60]

Shannon Lucid witnessed more of the changing opportunities for women in science and engineering in the 1960s and 1970s than her other female astronaut classmates. From the perspective of a struggling scientist, it seemed to Lucid that she might have had more job options available to her as an engineer in the 1960s. She was right in one respect: the United States was suffering from a national shortage of engineers.[61] In fact, since the job opportunities in engineering appeared better than in the sciences, she briefly considered a career change. But her personal observations of engineering culture suggested an environment at least as hostile and unwelcoming as that toward women in science. A number of female MIT graduates in engineering recalled corporate interviewers asking them directly how long they would stay at the job before quitting and questioned whether they could grasp mechanical details "like a man."[62] So Lucid stayed in science and hoped that changes would manifest themselves.

What would have to change first, and did eventually, was the law. Congress passed the Equal Pay Act in 1963 and the following year passed the Civil Rights Act. While these laws technically protected women against sexual discrimination in the workplace, their enforcement was often neglected. By the fall of 1964, a few prominent women scientists, such as sociologist Alice Rossi and industrial engineer Lillian Gilbreth, stepped up to challenge the treatment of women in nontraditional fields. Both spoke at the "Symposium on American Women in Science and Engineering" held at MIT in October 1964 to attract attention to the idea that women could be good engineers and scientists.[63] While the civil rights movement was making national headlines

and shaking things up around the country, people like Rossi lamented that none of these larger efforts seemed to focus any attention on the plight of women in the workplace. In response, women scientists began writing and publishing articles in scholarly journals, specifically *Science* and *American Sociologist*, and popular scientific journals such as *Psychology Today*.[64] For psychologist Naomi Weisstein, who had been active in civil rights protests in the mid-1960s, the fight for women's rights lacked a "draft card to burn"; women were marginalized and lacked a cohesive bond to unite them. So she, too, took the fight to the public forum by delivering lectures and writing articles about the discrimination she experienced as a woman scientist.[65] Like DACOWITS, which worked from its position of influence over the Department of Defense, women scientists brought awareness through their professional conferences, their universities, and their journals.

In 1972 the United States Congress passed the Equal Employment Opportunity (EEO) Act, a piece of legislation that finally validated the "sex" clause of the Civil Rights Act of 1964. EEO confirmed the illegality of sexual discrimination in hiring and firing practices. While the law helped to protect women's right to work and did secure openings for them, the culture and environment in the sciences and engineering took more coaxing, as would prove true for the NASA family as well.

When the federal laws changed, universities took a new look at women as science, and particularly engineering, students. Women were already struggling to find scientific and technological jobs after they left the universities. But as Shannon Lucid suggested, the on-the-job culture of engineering drove women engineers away, even from considering engineering as a college major. The 1972 legislation gave hope to the promoters of women's rights that things would begin to improve for women on the job.

Following EEO's passage, college campus organizations for female students of science and engineering continued to focus on recruitment and retention. At Purdue University, the recruitment campaign succeeded in increasing female engineering enrollment from forty-six in 1968 to more than a thousand in 1979, an increase of nearly 2,100%![66] But retention was the greater of the two challenges. Chapters of the Society of Women Engineers (SWE) around the country offered mentoring programs to freshman women engineering students and advice on finding summer jobs. University-funded programs also offered indoctrination classes for women unprepared

both mechanically and psychologically to handle the unique stresses they would face in a classroom filled mostly with men, who were potentially hostile to a woman's presence.

For those women who survived the classroom—meaning the demanding coursework as well as the potential discrimination and loneliness—the 1972 EEO laws opened doors. Employers used the federal law protecting the employment of eligible women as a marketing opportunity as much as a reason to hire women. A General Electric advertisement from 1974 pictured a young woman sitting at her desk under the headline, "We're Looking for Engineers Who Were Born to Lead."[67] Whether General Electric actually was successful in promoting women to leadership positions, an area where women engineers are underrepresented to this day, is beside the point of the ad.[68] But it did suggest to young engineering graduates as well as GE's consumers that the company was prepared to hire and even promote women engineers.

While changing federal laws in the 1970s helped open doors for women in engineering as well as those in science and aviation, the culture of a work environment could not be changed as easily. As discussions in later chapters will show, not even NASA was thoroughly prepared for what the introduction of women into the workforce meant for a workplace.

For NASA's astronaut corps, the changing laws and opportunities for women in science, engineering, and aviation in the 1970s meant that women finally had access to training and experience in the pipeline careers that the astronaut selection committees demanded from astronaut candidates. No law said that NASA could not have selected a woman astronaut before 1978. But changing the law led to a critical number of women both qualified and willing to fly in space from which NASA could select America's first women astronauts.

NASA certainly had the ability to put a woman in space well before 1983, when Sally Ride became the first American woman astronaut to fly. It was simply a matter of committing to such a project. The Soviets deemed putting a woman in space important enough that in 1963 they launched parachutist Valentina Tereshkova into orbit, a woman who had no acknowledgeable skills or experience as a pilot, scientist, or engineer for that matter. The United States had Jerrie Cobb, if it wanted to launch her. But prior to 1972 almost no women had any real opportunity in the astronaut pipeline fields of aviation,

science, or engineering. In addition, NASA was unwilling to alter its selection criteria for what would have been a token "first" as part of the space race. Selecting a female astronaut before 1972 meant that NASA would have set bold new precedents regarding women as Cold Warriors, a risky political move for an agency completely dependent on its public image for funding. It was far safer for the agency to wait until Americans were more comfortable with the idea of women in the professions and selecting them for the astronaut corps.

CHAPTER 2

Wilma Deering Meets Captain Janeway

The Soviet Union successfully launched Valentina Tereshkova, the world's first woman in space, aboard *Vostok 6* on June 16, 1963. This event was the culmination of decades-old, perhaps centuries-old, ideas of women in space. Even though NASA is the American organization that put people into orbit, science fiction has served as a powerful source of inspiration for space concepts. At the celebration of NASA's forty-fifth anniversary, history's first female Shuttle commander, Eileen Collins, credited the creativity and far-reaching imaginations of science fiction writers, actors, and directors for continuing to stretch their minds about the actual possibilities for humans in space.[1] Looking at the science fiction particularly of the 1950s and 1960s helps us understand the cultural conventions about women in space that would shape the experiences of America's first women astronauts.

From comic strips and graphic novels to television and film, science fiction served as a classroom for ideas about women in space. Female roles and popular figures in science fiction art and literature up to the space age typically lacked any true strength of character, influence on board ship or as part of the crew's command structure, or qualities that would suggest they were anything more than a good and wholesome female companion for their space pioneering men. From *Buck Rogers in the 25th Century*'s Wilma Deering to *Star Trek*'s Lt. Uhura, the women depicted in science fiction art and literature offered neither men nor women of the 1950s and 1960s a powerful or encouraging view of how women could contribute to America's space efforts. Through an analysis of some of the female characters found in mid- to late-century mainstream American science fiction, one can reconstruct the popular ideas about women in space and more largely how they shaped public support or disdain for those women who pushed to enter the astronaut corps.

The earliest and most prolific form of science fiction media to appear

might well have been the comic strip. One of the most memorable was *Buck Rogers in the 25th Century*. After making his debut in the novelette "Armageddon 2419 A.D." in the August 1928 issue of *Amazing Stories*, *Buck Rogers* splashed down into the funny papers in January 1929. Already a war veteran, Buck Rogers, the pilot-turned-surveyor, found himself trapped in an abandoned mine shaft where he succumbed to the influence of an unidentified gas, which put him in a state of suspended animation for five hundred years. When Buck awoke, the year was 2430.

For iconic science fiction writer Ray Bradbury, *Buck Rogers* challenged young boys to "be the future."[2] Buck Rogers took his readers with him to the Moon, Mars, the lost city of Atlantis, and Jupiter. New technologies such as "inertron" enabled a person to leap high in the air without the danger of crashing back to Earth. For all intents and purposes, people could fly. But the future portrayed in the comic suggested that little had changed for women.

In twenty-fifth-century America, as conceived by *Buck Rogers* writer Philip Nowlan and artist Dick Calkins, men and women carried equal burdens and Americans promoted sexual equality. Nowlan and Calkins seemed proud that their future vision of America offered the same rights, privileges, and duties to members of both sexes: "It was part of the education of all young girls to spend a certain amount of time in *military service* as well as in various industrial and mechanical activities."[3] Certainly their description of women's education suggests that women's opportunities for work in twenty-fifth-century America encompassed a larger selection of occupations than women had in the twentieth century even during wartime crisis. But in the reality of their comic strip world, Wilma Deering and her female compatriots' opportunities outside the home existed only until they married: "Then they adopted home-making as their career, and were subject to call for military or other service only in the case of emergency."[4] *Buck Rogers in the 25th Century* did little to change young boys' ideas about sexual equality. As a prognosticator for women, *Buck Rogers* predicted a world five hundred years into the future that expected identical gender roles compared to those of the present day.

The *Buck Rogers* creators did, however, take a giant leap forward by including women in the military and in roles on the front lines. Present-day politicians on Washington's Capitol Hill still engage in lively debate about women in combat. In science fiction's twenty-fifth century, Americans mostly abandoned the traditional duality between the sexes of protector/protected. This

can be seen in Roger's first encounter with a twenty-fifth-century American. Buck emerged from the mine shaft and stumbled into the midst of a firefight. Then at his feet fell Wilma Deering, a soldier fighting against the Mongols, conquerors of North America. Buck's response to seeing Deering reveals a 1929 point of view about women: "I now turned my attention to my newly found companion, and observed, as I carried her lightly to the nearby stream, that she was gloriously young and beautiful, and that her apparent lack of weight was due to the lifting power of the strange device strapped across her shoulders; for though slender, she was well developed, and there was firm strength in her lithe young body."[5] Although Buck had just awoken from a five-hundred-year sleep to find his world at war and *women fighting* in it, his instincts took over: by the sixth frame of the comic strip's history, Buck rescued the "damsel-in-distress." In challenging their readers to "be the future," Nowlan and Calkins fell short in their own thinking about what the future might mean for sexual equality and sexual identities.

In looking at how women were portrayed in science fiction art and literature, one can glean a perspective on how the general readership at the time viewed women as active participants in what was then the nascent era of space travel. Buck spoke of Wilma Deering as "that slender, blue-eyed golden-haired, high-spirited young *soldier-girl* who was destined to be my companion and capable assistant in so many astounding adventures in this marvelous universe." From the moment Buck arrived in the twenty-fifth century, Wilma dropped in rank from a fighting member in the Pennsylvanian Organization of soldiers to "capable assistant." In some frames, her incompetence was boundless. Strip 340 depicted Wilma standing before a control panel, bewildered by the display of gadgetry before her, and pondering, "O-o-o-oh! Suppose I should shoot the ship right out of the solar system! Or hit the Earth like a thunderbolt! B-but I have to do **something!** Well, **here goes!**" (bold in original).[6] Wilma Deering hardly would have inspired confidence in women's abilities to contribute anything short of amusement and companionship in space.[7] A reader picking up a *Buck Rogers* strip might wonder how Wilma ever survived alone on patrol duty without Buck around to rescue her. Her incompetence is palpable.

The artists and writers of *Buck Rogers* did give Wilma Deering opinions and feelings about the universe and the events surrounding her. Not all female characters in science fiction art possessed these qualities. Harry Harrison, a science fiction author and graphic novel artist, published his interpretations

of the portrayal of women in science fiction in a book entitled *Great Balls of Fire! A History of Sex in Science Fiction Illustration* (1977). For Harrison and much of the science fiction audience, a woman was something to rescue before the second-to-last frame.[8] Science fiction artists steered clear of developing their work for girls despite the fact that girls were part of the fan base.[9] "Science fiction was not only written for boys, it was *about* boys," Harrison wrote.[10] Whether the authors and illustrators meant to empower, encourage, or motivate young men to take their place in society as alpha males who controlled their worlds and those in it might best be left to speculation. But until the appearance of William Moulton Marston's *Wonder Woman* in December 1941, the drawings and messages clearly worked against the development of any young woman's self-worth and pride in her own abilities instead of merely her appearance. Further, they offered young men a view of women as limiting as their real-world experiences presented.

In the decade leading up to World War II, science fiction comics exhibited a racier nature than seen in the 1920s. However, because of the growing need during the war to refocus American concerns and sensibilities toward patriotism and stopping the spread of Fascism and totalitarianism, graphic artists and writers toned down the sexuality in their comics. Although no one ever mentioned or depicted sexual intercourse explicitly (or toilets for that matter), the drawings still provided a foundation upon which boys could build their own sexual fantasies. Harrison commented that comic book character Joe Palooka's girlfriend, Anne Howe, "never lifted a hemline nor bared a cleavage."[11] But the play on words found in her name ("And how!") provides enough subtle commentary about Miss Howe's nature and behavior to make any question about her physical form and sexual promiscuity seem unnecessary.

Science fiction artists and authors did not intend their works to be overtly sexy. Harrison wrote, "The libidinousness was appreciated mostly because it was not overt."[12] Like Anne Howe's wardrobe, a woman's clothes did not need to reveal bare skin for the character to be seductive. Compared to the male protagonists, a woman's wardrobe fit skin-tight. She might be covered, but she appeared "wrapped in transparent plastic like a candy box."[13] Wilma Deering's military-issue uniform, for example, came complete with leggings but included a short skirt and fitted bodice that accentuated the curves of her legs and breasts.

Harrison may be correct in his conclusion that science fiction's sexuality

was appreciated because of its unspoken nature. But women as sexual objects in science fiction played an important role in the sale of comics. Donald Wollheim, the editor of *Avon Fantasy Reader* from 1947 to 1951, found that without printing the image of a girl or woman on the front cover, the issues simply did not sell.[14]

As limiting as the appearance of sexually charged images on the front cover without any real substantive material about women within the pages of the issue was for female science fiction readers, what complicated matters further was that every woman portrayed was invariably and obviously European American. The only instances of cultural diversity in science fiction comics appeared as the dreaded antagonists. When Buck Rogers awakened after five hundred years to find himself thrown into a war, he discovered that the Red Mongols from East Asia had conquered North America.[15]

With regard to sexual equality, *Buck Rogers*'s challenge to young boys to "be the future" was a failure. But certainly *Rogers*'s artists and writers traveled in good company. "Who Goes There?" the best-known work by the recognized creator of modern science fiction John W. Campbell, tells the story of a group of Antarctic explorers fighting against a shape-shifting monster. Not surprisingly, no women undertook this arduous journey. Looking at the scope of comics that appeared between the 1920s and the 1960s, most would argue that science fiction comics were written *for* and *about boys*. Given this scenario, how did Marston's *Wonder Woman* fit into the picture?

There are two schools of thought about *Wonder Woman*. The first—to which Harry Harrison subscribes—argues that, as a psychiatrist, Marston wanted to create a comic personality with whom girls could identify. Marston noted in the *American Scholar* in 1943 that "not even girls want to be girls so long as our feminine archetype lacks force, strength, and power. Not wanting to be girls, they don't want to be tender, submissive, peace-loving as good women are. Women's strong qualities have become despised because of their weakness. The obvious remedy is to create a feminine character with all the strength of Superman plus all the allure of a good and beautiful woman."[16]

The second school of thought purports that Wonder Woman served as a teaching tool for its *male* readers that women can be strong. Marston commented, "It seemed to me, from a psychological angle, that the comics' worst offense was their blood-curdling masculinity. A male hero, at best, lacks the qualities of maternal love and tenderness which are as essential to the child as the breath of life."[17] Even though comics like *Buck Rogers* meant to portray

an American way of life that included women in the world of men, Marston rightly detected an overriding sense of masculinity and a lack of progressive change in women's roles. "Wonder Woman and the trend toward male acceptance of female love power which she represents indicated that the first psychological step has actually been taken," Marston said in a 1942 interview for *Family Circle*.[18] "Boys, young and old, satisfy their wish thoughts by reading comics. If they go crazy over Wonder Woman, it means they're longing for a beautiful, exciting girl who's stronger than they are."[19]

Interestingly enough, Marston suggested that to be a proper woman, she must be nurturing and submissive to men. His own difficulty in accepting that the qualities of a good woman—or a good man for that matter—could and should fluctuate with changing times tends to highlight the difficulties that women faced when they tried to break into traditionally male occupations. Marston openly encouraged the idea that women could be strong, powerful, and dynamic as long as those characteristics coexisted with the more traditional manifestations of the feminine gender. Marston's juxtaposition of masculine and feminine characteristics within one female comic personality emphasized the underlying issues that contemporary Americans faced when they discussed sexual integration of the workplace. Americans were asking whether women risked losing what made them feminine—simultaneously undermining what made men masculine—if they held equal status in the workforce.

The comic book industry experienced its boom in the 1950s. Harry Harrison noted that at that time over six hundred comic book titles were in print. With a minimum print run of two hundred thousand copies each, Harrison calculated that over 120 million comic books were circulating among the general readership. Given those numbers, one cannot discount the role science fiction comics played in shaping their readers' conception of human spaceflight endeavors. Nevertheless, comic books—and to a lesser extent comic strips—fell prey to niche markets more so than traditional books did. In the 1950s and 1960s it was science fiction novels that helped to shape popular ideas about men and women in space further.

One of the best-known authors in the genre of science fiction is Robert A. Heinlein. Author of *Starship Troopers* (1959) and *Stranger in a Strange Land* (1961), Heinlein helped to create some of the most memorable images of humans in space. The women in his stories, albeit talented and often more

skilled in some ways than the men around them, still tended to follow the social and sexual expectations of women in 1950s and 1960s America.

In Heinlein's future, the setting for *Starship Troopers*, Earth was at war with an alien race of insects. The nations of the world, while still independent entities, cooperated as part of a planetary federation, providing one unified army to fight a space war. Both men and women served in the military. But Juan Rico, Heinlein's main character, still harbored some animosity about the military jobs women performed: "When a female pilot handles a ship there is nothing comfortable about it; you're going to have bruises every place you're strapped. Yes, yes, I know they make better pilots than men do; their reactions are faster, and they can tolerate more gee. They can get in faster, get out faster, and thereby improve everybody's chances, yours as well as theirs. But that still doesn't make it fun to be slammed against your spine at ten times your proper weight."[20] Juan's two friends, Carl and Carmen, signed up with Juan for military service after high school graduation. Carmen, a pilot hopeful, asked Carl if he planned to try for a pilot position as well. Carl responded, "I'm no truck driver!"[21] Juan argued, "An infantryman can fight only if somebody else delivers him to his zone; in a way I suppose pilots are just as essential as we are."[22] The value and skill involved in piloting spaceships seems lost on Juan and Carl.

Already Heinlein's characterization of women in the workforce in *Starship Troopers* shows a distinct change in the culture's acceptance of a woman's place. No longer was the middle-class woman restricted to the kitchen or the working-class woman segregated into traditionally female work (more recently labeled pink-collar work); she was in the cockpit.[23] In America at the time of *Starship Troopers*' publication, the field of aviation had grown into a largely male endeavor. For Heinlein to write about women serving as pilots in his stories, he intimated that women possessed piloting qualities inherently superior to those of men. But *Starship Troopers* contained enough references to the "proper place" for women to suggest that progress toward sexual equality in Heinlein's future did not extend much beyond a few pivotal occupations.

Both men and women served on Juan Rico's ship, the *Rodger Young*, creating a special situation of which all the men on board had a subtle awareness: "The *Rodger Young* was a mixed ship, female captain and pilot officers, some female Navy ratings; forward of bulkhead thirty was ladies' country—and two

armed M.I. day and night stood guard at the one door cutting it." Even more so than U.S. naval vessels since 1993, the *Rodger Young* of the future was quite segregated. At least in his writing, Heinlein did not seem convinced that officers could share a meal together and still act professionally: "Officers were privileged to go forward of bulkhead thirty on duty and all officers, including the Lieutenant, ate in a mixed mess just beyond it. But they didn't tarry there; they ate and got out."[24] Today's military leaders take a strong stance on fraternization. Since a military's success hinges as much on the chain of command system working in the heat of battle as on its system and technical prowess, it is reasonable to have policies forbidding officers and enlisted personnel from dating. But on the *Rodger Young* even officers from different military branches (in this case the army and the navy) were uncomfortable interacting as colleagues in after-dinner conversation. The cockpit might have become one of women's proper places, but only so they might do their jobs and then, hopefully, disappear.

Robert Heinlein's best-known book, *Stranger in a Strange Land*, offered an even less positive image of women's personalities and social standing than *Starship Troopers*. Published in 1961, it became an international bestseller and won the Hugo Award, science fiction's prize for achievement. It has even been credited as the blueprint for the "free love" movement and the bible for the counterculture of the 1960s.[25] A lot about 1960s culture in the United States was liberating and empowering, but like other aspects of 1960s culture, *Stranger in a Strange Land* offered little encouragement for its female readers.

Stranger in a Strange Land told the story of Valentine Michael Smith, the son of two humans on Earth's first Mars expedition.[26] As the only survivor, Smith grew up in a Martian environment and culture. A rescue mission—made up of all men—"returned" Smith to Earth. The book told his tale of integration into our "alien" culture, including Smith's first ever experiences with women (Martians are sexless creatures).

Set a century or so into Heinlein's future, Americans traveled in automated flying cars. They lived in apartment buildings with communal kitchens and, if one was lucky, real living grass rugs. Social reformers of the 1920s, such as Charlotte Perkins Gilman, and again in the 1970s toyed with the concept of community kitchens as a way to free up women's lives from the toils of family responsibility, giving them an opportunity to share their talents

with the world. For the women in *Stranger*, however, their opportunities in the workforce remained largely traditional—nurses and secretaries, specifically. Jill, the female protagonist and Smith's guide to American culture, met Michael for the first time as his nurse when he was hospitalized during his adjustment to Earth's stronger gravity.

Prior to Smith's arrival on Earth, he had no cognizance of "woman." The four women on board the original expedition to Mars all died when he was still young. Planners for the first mission to Mars anticipated that the trip would be fraught with greater psychological burdens than physical ones. Therefore, they vetoed the idea of sending a crew of eight men as "unhealthy and socially unstable."[27] The women served essentially as buffers. An all-male crew was able to undertake the rescue mission thanks to the newly developed "Lyle Drive," which shortened the one-way trip to nineteen days.[28] When Smith arrived on Earth, his physicians were adamant that "they don't want no bims [bimbos] around him," afraid that his shock and sexual excitement over seeing a woman for the first time might kill him.[29] Heinlein carefully created the character of Jill as a very benign experience for Michael, for "outside her knowledge of nursing and of the joyous guerilla warfare between the sexes, Jill was almost as innocent as the Man from Mars."[30]

Although *Stranger in a Strange Land* took place almost entirely on Earth and not in space, Heinlein's depiction of women as silly, naïve, and childlike in their understanding of human nature and the world around them worked to undermine any endeavors to improve the standing of women as valuable contributors to society. Even the brand name that Heinlein gave to a birth control medicine, *Wise Girl Malthusian Lozenges*, perpetuated the idea that only a young and stupid woman would make the mistake of accidental pregnancy.[31] His message about female intelligence and women's abilities to learn was not entirely negative, but neither was it enlightened about the contributions women could make to society. The four female members of the first Mars mission were each married to a male member of the crew and experts in a specialized area of science or engineering. In this way, Heinlein projected a clear message that no woman on board such a mission would go along only for conjugal reasons; she would have to earn her keep as well.

As Michael Smith's exposure to Earth continued, he met eclectic and reclusive Dr. Jubal Harshaw. Harshaw survived on his healthy income from writing short stories and columns for various publications around the world. His

writing process involved three women—his extraordinarily talented secretaries, Anne, Dorcas, and Miriam—to whom he dictated his thoughts whenever he yelled "front." They memorized every word he dictated to them and then recorded it all on paper at a later time. Given these skills (not to mention that they provided Jubal with superbly cooked meals), they were not typical assistants! But when they interfered in his life in ways he disliked, he exclaimed, "We should never have put shoes on 'em."[32] Anne, Dorcas, and Miriam always ignored Jubal's off-handed comments. But Jubal obviously lamented the changes in society that had empowered the women in his life. Although he is the book's deepest thinker and truest philosopher, Jubal's thoughts about the roles of men and women in society discouraged ideas about social development and sexual equality.

As influential as Robert Heinlein, Arthur C. Clarke wrote science fiction novels, such as *Rendezvous with Rama*, that shaped many readers' ideas about the future. And like Heinlein, Clarke did not promote feminist ideas about women as equal members of the workforce.

In *Rendezvous with Rama* (1973), astronomers of twenty-second-century Earth tracked an unidentified object as it entered the solar system. At fifty kilometers in length and twenty kilometers wide, *Rama* posed a significant threat to Earth should the two collide or experience a near miss, potentially altering the earth's orbit and climate. SPACEGUARD, the organization responsible for keeping Earth safe from extraterrestrial events since an asteroid destroyed the cities of Padua and Verona in 2077, sent a team of its own to rendezvous with *Rama* and discover its intentions: "The long-hoped-for, long-feared encounter had come at last. Mankind was about to receive the first visitor from the stars."[33]

Commander William Norton headed up the almost entirely male crew of the *Endeavour*, the ship sent to investigate *Rama*. Norton shared a "special" relationship with the one female officer on board, Surgeon Commander Laura Ernst, having once made love "in a moment of mutual loneliness and depression."[34] Clarke made clear that this one-time fling served as the foundation for Norton's ideas about women serving on ships. But the idea was rooted in a more fundamental idea about women as sex objects:

> Some women, Commander Norton had decided long ago, should not be allowed aboard ship; weightlessness did things to their breasts that were too damn distracting. It was bad enough when they were motionless; but when they started to

> move, and sympathetic vibrations set in, it was more than any warm-blooded male should be asked to take. He was quite sure that at least one serious space accident had been caused by acute crew distraction, after the transit of an unholstered lady officer through the control cabin.[35]

One can interpret a lot about Commander Norton from his comment. Rightly, he might hold his opinion about women on board ship because of his experience with Commander Ernst. But his preference to exclude women because one particular woman made him uncomfortable clearly represented a prejudice. Norton overlooked the skills and abilities that any woman, including Commander Ernst, might bring to the mission based simply on the fact that she possessed breasts. Barriers to women in the workplace typically fell when economic and staffing needs justified hiring women in positions done historically by men, the government legislated the illegality of sexual discrimination, or the employer could no longer prove that women either could not perform the tasks involved or were put at undue risk. Given that *Rendezvous with Rama* appeared in bookstores in 1973, a year after Congress passed the Equal Employment Opportunity Act, Norton's opinion reflected common attitudes in America at the time and potentially helped perpetuate the resistance to sexual equality and embittered the fight. In looking back, one might laugh at and overlook the sexism of *Buck Rogers* and Robert Heinlein because their ideas about women in the workplace were consistent with the contemporary popular feelings. But Clarke's Commander Norton and his bold statements published in 1973 border on social irresponsibility.

Even though Commander Ernst and Executive Sergeant Ruby Barnes (the only other female character in *Rendezvous with Rama*) served on board the spaceship *Endeavor*, they did not hold the status of "astronaut." Clarke wrote, "Like every astronaut, Norton had been sterilized when he entered the service."[36] Sterilization served as a precaution against inevitable space radiation–induced birth defects. But Norton also contemplated the fact that during his career he had endured just about every problem a commander could "except the classical one of an unscheduled birth during a mission." He noted, "Though this situation was the subject of innumerable jokes, it had never happened yet; but such gross incompetence was probably a matter of time."[37] If women were permitted to be astronauts, presumably the same expectation of sterilization would hold for them as it did for the men. While a sterilized woman could potentially still give birth, it would require medical skill and

planning far beyond the level suggested by "gross incompetence." One was to assume that since the women on board were not sterilized, they were not astronauts, either.

Clarke's writings suggest that he shared a similar perspective on pregnancy as Heinlein. For Clarke, women who become pregnant during a mission suffered from "gross incompetence." In Heinlein's eyes, smart women invested in prophylactics, like *Wise Girl Malthusian Lozenges*, and avoided any "unscheduled births." Heinlein took heterosexual intercourse a step further in having Jill surmise that "nine times out of ten a girl who is raped is somehow asking for it," a challenge prosecutors of rape cases still face.[38] By and large, neither Heinlein nor Clarke expended too much ink discussing the roles of women in their futuristic worlds. But their treatment of women suggested that they never accepted William Moulton Marston's philosophy that men thrived under the influence of strong women. Readers needed to abandon authors like Clarke and Heinlein to find even a neutral discussion of sex in science fiction. Ursula Le Guin provided that.

Le Guin, whose father was an anthropologist and whose mother wrote as well on the history of Southwest and Californian Native Americans, used science fiction as a social thought experiment. As a self-proclaimed anthropologist, Le Guin felt that science fiction should not be thought of as a prediction of the future, but "to describe reality, the present world. It is descriptive."[39] Her treatment of masculinity and femininity bore witness to the world around her. In 1969 when she published *The Left Hand of Darkness*, the second feminist movement had taken hold of the popular consciousness in a way that women's rights had not done since the 1910s. Although Le Guin never described herself as a feminist, she certainly challenged her readers to understand why the conflict between the sexes existed and whether it should continue.

The Left Hand of Darkness postulated Earth ambassador Genli Ai's mission to an androgynous world. He carried with him an invitation for the inhabitants of the planet of Winter—named by humans for its climate—to join the Ekumen interplanetary federation, of which Earth was a member. The Gethenians, who lived on Winter, tended to distrust strangers. Therefore, Ai had to live among them for several years before getting an audience with the king. In the five Earth years Ai spent on Winter waiting for his royal interview, his understanding of Gethenian sexual physiology and procreation grew.

Ai learned that any Gethenian might take a female form and bear a child, all depending on how the two sexual partners came together during their periods of fertility. Le Guin created a world of sexual equality in this way because no one carried less risk than another from being "tied down to childbearing. . . . Nobody here is quite so free as a free male anywhere else."[40] The sexism inherent in Clarke's and Heinlein's treatment of women, simply because they gave birth, disappeared in Le Guin's world. The larger consequence of such a social system, however, was that the dualities of sex as existed on Earth also disappeared. No one characterized people by their sex as strong or weak, protective or protected, dominant or submissive, owner or chattel, or active or passive.[41] In a two-sex society, Le Guin noted, "A man wants his virility regarded, a woman wants her femininity appreciated, however indirect and subtle the indications of regard and appreciation." By removing those physical sexual differences, Le Guin conceived a world without socially constructed gender differences. What is the proper behavior for a man? For a woman? If a person fails to live up to the social expectations of one's sex, is it fair to identify him or her as deviant? For Gethenians, deviance existed when someone chose to be one sex all the time, to be continually female or male. *The Left Hand of Darkness* as a thought experiment about a world without sexual discrimination challenged its readers to reexamine the rationality of sex and gender divisions in society.

Of course, Ursula Le Guin did not expect humans to evolve into a sexless society. Instead, her works encouraged readers to find strengths in sexual difference and to learn and benefit from them.[42] In her short story "The Space Crone," Le Guin took on the persona of a woman experiencing menopause. In the story, she lamented society's failure to recognize the real gift of menopause, "the opportunity to become a Crone."[43]

Le Guin saw menopause as the third stage in a woman's life, having moved from virginity to fertility and finally to infertile maturity. Her sadness lay in the fact that society often viewed menopausal women as beyond the point at which they can contribute something to society. For Le Guin, menopause could give a woman strength: "There are things the Old Woman can do, say, and think that the Woman cannot do, say, or think. It seems a pity to have a built-in rite of passage and to dodge it, evade it, and pretend nothing has changed."[44] So often, however, society saw menopause as a time when a woman lost her one inherent ability—to bear children. Without understanding the value of women beyond just their reproductive function, society lost

the wisdom of its older generations. For Le Guin, the loss was inexcusable, and she used "The Space Crone" to show what older women had to offer: "If a space ship came by from the friendly native of the fourth planet of Altair, and the polite captain of the space ship said, 'We have room for one passenger; will you spare us a single human being, so that we may converse at leisure during the long trip back to Altair and learn from an exemplary person the nature of the race?' " Knowing exactly who to call upon, Le Guin answered, "What I would do is go down to the local Woolworth's, or the local village marketplace, and pick an old woman, over sixty, from behind the costume jewelry counter or the betel-nut booth." Ruling out the young male and female volunteers as an option, Le Guin concluded about her space crone, "She has a stock of sense, wit, patience, and experiential shrewdness, which the Altaireans might, or might not, perceive as wisdom. If they are wiser than we, then of course we don't know how they'd perceive it. But if they are wiser than we, they may know how to perceive that inmost mind and heart which we, working on mere guess and hope, proclaim to be humane. In any case, since they are curious and kindly, let's give them the best we have to give."[45] What Le Guin saw in women that authors like Heinlein and Clarke overlooked was an intelligence and perception of the world that men did not necessarily possess. This was not to say that men could not influence the world in the profound ways that women could, but it argued that women had a right to be heard. Le Guin challenged her audience to consider what the world would be like if we recognized the gifts of women.

The availability of science fiction comics and novels was comparable to most other genres, but beginning in the 1960s, television offered the quickest access to stories about space travel and the future and perhaps to more people who otherwise may not read science fiction. In 1964 Gene Roddenberry wrote the script for a television series that ultimately gave America some of its best science fiction stories of the twentieth century. NBC contracted with Roddenberry to make one pilot episode of *Star Trek*, entitled "The Cage." At the time, the studio was riding high on the success of its shows set in the American West, and so it asked Roddenberry to write "a Western to the stars."[46] The final product, far from anything management hoped for, told a story much more consistent with modern science fiction and with the issues humanity struggled to resolve—love, war, God, nature, and sex. The studio rejected the pilot, but a top program executive told Roddenberry that he felt like he was actually flying in space and asked for a second pilot to be made.

The second pilot, titled "The Menagerie," built on some of the ideas developed in "The Cage" but with enough changes that NBC's managers accepted the series.

Star Trek: The Original Series (as it is now known since the airing of subsequent series by the same name; hereafter referred to as *ST:TOS*) ran from September 1966 to June 1969, concurrent with NASA's Apollo program, the Vietnam War, the civil rights movement, and the second women's movement. As Roddenberry had hoped, the series dealt with a number of the very issues that the country faced during its run. War, race relations, and sexual equality all appeared as topics of the show. Unfortunately, the studio did not permit Roddenberry to deal with all of these issues as prominently as he would have liked, most notably the issue of sexual equality.

When Roddenberry filmed "The Cage," he tried something remarkably cutting-edge. He gave the role of the ship's first officer to a woman. Majel Barrett, Roddenberry's lover and future wife, played the role of "Number One," Captain Christopher Pike's second in command. Roddenberry drew particular attention to the fact that women served as active members of the crew, even if his main character was not comfortable with the idea. In the episode, the starship *Enterprise* had recently run into some nefarious aliens, resulting in the death of a few of her crew members. Pike's yeoman, who had been killed in the incident, was replaced by a young woman named Gilman. When Gilman appears on the bridge to deliver Pike a report he was expecting, Pike yelled, "Gilman, I thought I told you when I'm on the bridge, I don't want you [here]!" Number One pointed out, "She's replacing your former yeoman, Sir." Pike replied almost apologetically, "She does a good job alright. It's just that I can't get used to the idea of having a woman on the bridge." Realizing his faux pas, Pike said, "No offense, Lieutenant. You're different, of course."[47] His first officer's reaction suggested that she did not know whether to be more bothered by her captain's discomfort with having women on the bridge or by the implication that he could not see her as both a valued officer and a woman.

As Pike noted, the lieutenant was not the typical 1960s woman. Roddenberry wrote the character to have a highly superior computerized and logical mind. During the crisis moment of the episode, she listened to the suggestions made by the senior staff, but she made her own decisions. Number One represented, in many ways, what William Moulton Marston envisioned for Wonder Woman. She was strong and self-confident but also proud of

her femininity. Even Yeoman Gilman interrupted the captain's tirade about women on the bridge to remind him that she was rightfully there to deliver the reports he had ordered. But when Roddenberry showed the pilot to a studio test audience of women, they asked, "Who does she think she is!?"[48] Appearing the year after Betty Friedan published *The Feminine Mystique*, in which she criticized the social mores that encouraged women to stay in the home, "The Cage" further ruffled the feathers of the women already insulted by Friedan's suggestion that the feminine mystique was holding back American women, especially suburban middle- and upper-class women, and their creativity. Pike's nameless first officer represented a woman who would not accept her sex or misogynistic comments as limits to her own success. *The Feminine Mystique* may well have been the seminal feminist work of the 1960s and in part responsible for the birth of the modern women's movement, but the reactions to Roddenberry's efforts to raise the public consciousness of women's rights suggest that Americans did pay attention to science fiction art and literature.

The restructured version of *Star Trek* that NBC producers ultimately adopted does highlight important contemporary social and women's issues. Consider the senior staff on board the starship *Enterprise* from the original series. Captain James T. Kirk commanded the ship. His trusty counterpart and science officer Mr. Spock balanced the captain's bold spirit for exploration with his restrained Vulcan logic. Ensign Pavel Chekov (Russian) navigated while Lt. Hikaru Sulu (Japanese) served as the helm officer to keep the vessel on its course throughout the universe, both of whom added to the inclusiveness of the show. Dr. Leonard "Bones" McCoy provided his special form of medicine, often laughter, to his patients in Sickbay. Lt. Commander Montgomery Scott maintained the ship's systems and engines, always tweaking things to get just a little more power from the system. Lt. Uhura answered the phone. Of course, as communications officer, Uhura was the ship's only link to the worlds outside the ship. But no one performed any job that a contemporary American of the same sex would not ordinarily perform. The men commanded, acted logically, studied science and medicine, engineered, and piloted. The women answered the phone and worked as nurses —Christine Chapel, MD, worked as Dr. McCoy's nurse in Sickbay.

Uhura and Chapel provided viewers with some very interesting public commentary about women. Officially, Lt. Uhura was the only human staff officer without a first name.[49] Fans of the show and unofficial websites gave

her a first name, Nyoto, but official sources never used that name until the release of the eleventh movie, *Star Trek*, in 2009.[50] Producers downgraded Majel Barrett's role from first officer of the *Enterprise* to that of Nurse Chapel for the second pilot and for the remainder of the series. In his daily life, Gene Roddenberry was very sensitive to issues surrounding minority Americans. By casting Nichelle Nicholls and George Takai to play Lt. Uhura and Lt. Sulu, respectively, he created one of the earliest shows to include more than just white actors. A *TV Guide* article celebrating the series' thirtieth anniversary in 1996 commented on the broad ethnicity of the show, stating, "*Trek* boasted an Asian, a Scotsman, a friendly Russian, and even an African-American woman with a real important job."[51] But considering the limitations placed on the characters of Uhura and Chapel, one might conclude that taking on the fight for women's rights in the mid- to late 1960s simply proved too difficult a battle for Roddenberry.

When talking about the contributions and images of women in *Star Trek*, the "space babes" cannot be ignored. William Shatner's character, Captain James T. Kirk, had "a girl on every planet." A number of the women cast as Kirk's love interests spoke to *TV Guide* for the anniversary issue. In reply to whether Kirk's behavior was sexist, Louise Sorel, who played an android woman named Rayna, said, "That was episodic television of the '60s. You had to bring in a woman every week who was sort of titillating—pardon the pun—so it never occurred to me to be offended."[52] These women were largely responsible for the image of the "space babes"—short skirts, small waists, big hair. Grace Lee Whitney, better known as Yeoman Janice Rand, recalled, "We got that look together and showed it to Gene [Roddenberry]. He just about fell off his chair."[53] Roddenberry's approach to respecting diversity and civil rights might best be described as noble, just ahead of his time.

At the same time that Roddenberry was trying to push forward American ideas about women, one motion picture confirmed the prejudices that dominated the comic strips of *Buck Rogers* and the novels by Heinlein and Clarke. That movie, *Barbarella: Queen of the Galaxy*, premiered in 1968. It portrayed an Earth woman, Barbarella (played by Jane Fonda), as a "Five Star double-rated aeronautrix" commissioned by the president of Earth to bring a rogue scientist, Dr. Durand Durand, back to Earth. Dr. Durand, having grown disillusioned by the centuries-long peace in the universe, was building a weapon that he intended to give to an "underdeveloped" world. Barbarella accepted the job, but she was attacked as she approached the planet where

she suspected Dr. Durand to be and was forced to crash-land. Although Barbarella was initially portrayed as the potential hero of the universe, she quickly became the "damsel-in-distress."[54]

After crash-landing, Barbarella accepted the help of the Catchman, who kidnapped children of "serviceable age" and sold them into slavery. As these children had attacked Barbarella's ship, she showed no revulsion over the Catchman's job and accepted his help to repair her ship. In return for his help, Barbarella agreed to have sex with him. Since coitus was an archaic practice on Earth (partners instead shared a neural connection), making love to the Catchman overwhelmed Barbarella. Not only did Barbarella transition from "Queen of the Galaxy" to damsel-in-distress in the film, but she also turned into an insatiable nymphomaniac who ultimately short-circuited Dr. Durand's "Orgasmotron," the weapon he designed to kill people by sexually overstimulating them. In addition to becoming singly focused on sex, Barbarella was rescued no less than five times during the course of the movie.

The film and main character of *Barbarella* are based on a science fiction comic book written by French author Jean-Claude Forest. At some level, the character is consistent with American culture in 1968; Barbarella is arguably the model woman in the era of sexual liberation. But her newly discovered sexuality came at the cost of her self-reliance and personal strength. Barbarella's survival at the conclusion of the movie ultimately depended on Pygar, the blind, winged man or "ornithrothrope" she identified as an angel. Despite being an intense female character, Barbarella only perpetuated the feminine stereotype. Although she was sexually liberated, she was dependent on men for her survival. Compared to *Star Trek*, its small-screen contemporary, *Barbarella* provided young men with erotic fantasies of space but undermined any ideas they may have had about women as equals.

Despite *Star Trek*'s popularity with its television audience, the studio cancelled all production on the show in 1969 after seventy-nine episodes. But fans and supporters of Gene Roddenberry's vision of and for the future of space exploration found ways to reinvigorate *Star Trek*. Five series, eleven movies, and dozens of novels eventually kept fans coming back for more. But given changes in public consciousness and awareness about equal rights, the writers and directors made increasingly serious efforts to pursue some of Gene Roddenberry's more profound ideas for his show.

Star Trek: The Next Generation (*ST:TNG*) made its television premiere in 1987. By this time, NASA had flown its first female astronauts and also

experienced its first loss of female astronauts with the destruction of the Space Shuttle *Challenger* on January 28, 1986, killing astronaut Judith Resnik and teacher Christa McAuliffe along with their five male crewmates. The days of assigning women to unassuming roles in downplayed positions on any television series set in the future, as Roddenberry felt obligated to do in the 1960s, were over. By the twenty-fifth century, the time frame for *ST:TNG*, the tactical officer handled communications. From 1987 to April 1988, Denise Crosby played the role of the tough-skinned chief of security Natasha Yar. Crosby's departure from the show left her position open for her second-in-command to the ship's Klingon officer, Lt. Worf, to fill. As a Klingon by birth, the character of Worf possessed a bloodlust for combat. A Klingon's life centered on duty and honor. Yar serving as his commanding officer made a positive statement about not only the leadership skills that women can possess but also their strong sense of personal strength and value to lead a born warrior.

Dr. Beverly Crusher, played by Gates McFadden, and Lt. Commander Deanna Troi, Marina Sirtis's character, formed the top echelon of the *Enterprise* medical staff, one as the chief medical officer, the other as ship's counselor. In an interview, Sirtis stated her belief that "Roddenberry and the show's writers inadvertently thrust Troi and Dr. Beverly Crusher into a dramatic black hole by assigning the characters 'nurturing' professions."[55] But over the seven-year series, both characters' influence and presence grew significantly, offering "more dramatic meat than could ever be hoped for by an actress portraying a counselor or a starship's doctor."[56] The result was beneficial. Gates McFadden noted, "I run into children and get letters from people who are affected in a positive way. People look up to the characters as role models."[57] One could find it interesting, however, that Dr. Crusher's position—identical to that of Dr. McCoy from the original series—should be interpreted as "nurturing." What must a woman do before society sees her as someone just doing a job instead of performing a womanly task?

The producers of *Star Trek*'s numerous incarnations have worked hard to downplay sexual inequalities. When Gene Roddenberry died in October 1991, his wife of twenty-three years, who was also the pilot episode's "Number One" and the former "Nurse Chapel," Majel Barrett, stepped up to help producers Michael Pillar and Rick Berman interpret Roddenberry's dream and vision for *Star Trek*. Thinking back to the original pilot from 1964, Barrett said that she wondered what might have been for Number One if

NBC had accepted the pilot: "I look back on that at least once a day and have for 28 years."[58]

Even before *ST:TNG* ended in 1994, the next iteration, *Star Trek: Deep Space Nine* (*ST:DS9*), hit the airwaves. The new series, set concurrently with *ST:TNG*, followed the experiences of the crew working aboard Starfleet's Deep Space Station Number 9 in orbit around the planet of Bajor. Commander Benjamin Sisko commanded the station with his first officer, Major Kira Nerys, a female Bajoran freedom fighter.

As a consequence of growing up an orphan in a refugee camp, Major Kira lacked tact and patience in her interpersonal relationships. Sisko often found himself forced to temper Kira's enthusiasm and gusto in the midst of tense situations. For calm and wisdom, Sisko turned to his science officer, Jadzia Dax. A member of the Trillian species, Jadzia was the female host of the sexless Dax symbiont. Sisko knew Dax before as Curzon Dax, whom Sisko affectionately called "Old Man." That was what Curzon Dax was when Sisko knew him—an old man. The symbiont carried its memories and experiences from each previous host to the next. So even though Jadzia was a young woman, her collective wisdom provided Sisko with a bountiful wealth of knowledge and reason. Although often overlooked as the "dark side" of *Star Trek*, *ST:DS9* offered its audience some of the strongest female characters in *Star Trek* history.

In 1995, just weeks before Eileen Collins made history as the first female Space Shuttle pilot, *Star Trek* again made another of its own statements about women in space. For the first time, a woman commanded a starship. Captain Kathryn Janeway, actress Kate Mulgrew's character, commanded the Federation starship *Voyager* on its maiden voyage. Sent to chase down a band of renegades, *Voyager* and her crew traveled to "the Badlands." There the ship encountered an unknown life-form that hurled *Voyager* and the renegades into an uncharted quadrant of space, completely cut off from home. In true *Star Trek* spirit, Janeway and her ship's now ragtag complement of Starfleet personnel and outlaws had "boldly gone where no one has gone before." In no other series had the Federation left a ship on its own and without guidance. But circumstances in *Star Trek: Voyager* make it possible for the first female captain not only to stretch her wings but to fly on her own.

The most recent incarnation of *Star Trek* on the small screen brings the concept full circle. *Enterprise* was the prequel to *ST:TOS*. Only a century after humans achieved warp speed, the newest member of the Federation of Plan-

ets, Earth, set out to explore the universe under the reserved guidance and tutelage of Vulcan emissaries. Again, a woman, Hoshi Sato, served as the communications officer. But in the forty years separating the original series and *Enterprise*, the role of the communications officer now seemed much more important to the success of the crew's mission than before. Uhura's job entailed relaying messages and modifying equipment settings to make that possible. Sato secured her position on *Enterprise* through her skills as a prodigious linguist who could master basic communication skills in almost any language with minimal exposure. One piece of *Star Trek* magic that made the entire endeavor possible was the universal translator, which allowed humans to converse with any alien species using only human language. Sato programmed the universal translator based on algorithms for each language that she constructed using her linguistic knowledge. More so than Uhura, Sato made communication possible.

Another woman played a significant role in *Enterprise* that no other version of *Star Trek* had tried since the 1982 film, *Star Trek II: The Wrath of Khan*. Every version of *Star Trek* has one "creature of logic," one person who always offered the most rational, unemotional perspective on an issue. Usually the "creature of logic" was Vulcan, a race of humanoids that valued above all the importance of logic and caution for emotions. *ST:TOS* had Spock. *The Next Generation* used Data, an android programmed without human emotions. *ST:DS9* introduced Odo, the station's shape-shifting constable, who prided himself on his clear-cut policies and practices in maintaining the station's security. *Voyager* and *Enterprise* both had Vulcans serving on board. But on *Enterprise*, the Vulcan was a woman named T'Pol. Given the long history of gendered ideas about women, for the "creature of logic" on *Enterprise* to *not* be a man suggested a marked change in perspectives about the sexes since the original series appeared in the 1960s.

Whether a woman submitted to them or not, society judged women by a "complex of virtues."[59] Psychologists in the 1920s used surveys designed to quantify normal masculinity and femininity and identify deviance. But the questions themselves were loaded with socially constructed ideas about gender. A man gained masculinity points by answering negatively to the question "Do you like people to tell you about their problems?" or "Do you like women who are cleverer than you?" Women gained femininity points when answering that they disliked sideshow oddities, riding bicycles, and playing with snakes.[60] Society expected its men to exhibit strength, intelligence,

dispassion, stoicism, nationalism, and superiority. Women's normalcy depended more on their frailty, nurturing quality, domesticity, passion, sensibility, quietness, and submission. On board *Enterprise*, T'Pol was intelligent, unemotional, and logical. Her Vulcan physiology and training gave her a physical advantage in a fight over most human men. The reactions given by the original *Star Trek* pilot test audience to Number One suggested that the "complex of virtues" valued in women had not changed much since the 1920s. The evolution of the series from Number One to T'Pol offered both a reflection of and hope for society's perspectives about women.

As a commodity sold to its consumers, science fiction art, literature, and entertainment needed to complement the sensibilities of the general public. Like *Star Trek*'s "The Cage," science fiction that forced its audience to reevaluate social conventions found itself sequestered to the genre of pulp fiction or ignored altogether. With changes in public perceptions about women, some of the earlier works that emphasized greater equality between the sexes began to make a reappearance. The Feminist Press of the City University of New York began publishing a number of pulp and science fiction works by feminist writers, which never had much of an audience in the past given their strong female representations.

The Feminist Press published one book in particular, *The End of This Day's Business* by Katherine Burdekin, which she wrote in 1935 but never published. She set the story four thousand years into Earth's future. After the disastrous events of the twentieth century (war and fascism), women took over the world's leadership, leaving the once-powerful men to "accept their 'natural' inferiority."[61] The new society reflected utopian ideals where different cultures coexisted without nationalistic competition, war, or violence. Given the opportunity to grow, women found that they developed very strong psyches and were no longer "dulled by sex-shame."[62] The price of such a peaceful world led by "stronger and better" women was the subjugation of men. By reversing the power roles, Burdekin argued that deference to one sex over the other undermined the integrity of the entire system. In 1935, Burdekin's writing reacted mostly to the world beginning to change under Hitler and Mussolini. But her use of sex as her tool for discussing discrimination and the dangers of social hierarchies predated American culture's readiness to deal with strong women.

By selecting some of the more popular science fiction works and titles from the 1930s through the present day, one sees the change in society's ideas

about women's roles. Beginning at a time after the Suffrage Amendment was passed in 1920 and when women lacked a strong rallying point for further advocacy, science fiction art and literature portrayed women as little more than props or sexual playthings. Wilma Deering served as Buck Rogers's "damsel-in-distress" even though her experiences in the twenty-fifth century amounted to much more knowledge than Buck could have hoped to possess. For Heinlein and Clarke, women may have proven themselves valuable assistants, but the men in their lives still felt that the women should not "worry their pretty little heads."[63] By the time Ursula Le Guin and Gene Roddenberry began challenging women's roles in their work, organizers of the second women's movement had begun to reformulate their tenets. Opponents of women's rights had lost some of their dominance and ability to squash feminist arguments and stories. Even in the 1960s as ideas about sex and gender roles began to change, *The Left Hand of Darkness* and *Star Trek*'s "The Cage" still struck sensitive nerves. Following the evolution of *Star Trek* over four decades from its conception in 1964 demonstrates how well science fiction has mirrored public perceptions of gender, as it has with race and war.

But even as science fiction depicted society's larger position on gender, a handful of women chose to overlook the messages in science fiction and the boundaries set by society about their proper place in the world. Given reason to dream, they set their hearts and minds on the idea of spaceflight. American society and politics, however, squelched their hopes of achieving a first for both their country and their fellow women in the space race with the Soviet Union.

CHAPTER 3

"The Damn Crazy Things!"

Between February 1960 and July 1961, thirteen women underwent, and passed, medical tests at the Lovelace Foundation in Albuquerque, New Mexico, physical and psychological examinations highly similar to those given at the clinic to the astronaut candidates who became the original Mercury Seven.[1] Masterminding the program was Dr. W. Randolph Lovelace, the chief physician of the Albuquerque clinic, who, after completing tests on the men destined to become the nation's first astronauts, wondered how a group of the nation's best women pilots would stack up to their male counterparts.

Dr. Lovelace was not the first person to explore such an idea. As a publicity stunt for *Look* magazine in 1959, 33-year-old aviatrix Betty Skelton had participated in some astronaut exercises at an air force base in San Antonio, Texas. *Look* reported the results of Skelton's testing in a fall 1959 article, "Should a Girl Be First in Space?"[2] Around the same time, fellow pilot Ruth Nichols, a stately 58-year-old, submitted to aeromedical tests at the Wright Air Development Center in Dayton, Ohio. Independent of Nichols's testing, but also in Dayton, Air Force Brigadier General Donald Flickinger, from his office of Air Research and Development Command (ARDC), initiated his own research program on women and spaceflight. When the ARDC promptly cancelled the fledgling project, Flickinger transferred sponsorship of the program to Dr. Randy Lovelace, his friend and colleague.[3]

The first woman of the thirteen to be tested by Lovelace was Geraldyn Cobb, an experienced and accomplished aviator. Not yet 30 years old in 1960, "Jerrie" Cobb felt at the time that she might actually get the chance to fly in space.[4] But it was a dream soon shattered. Even though Cobb and the other twelve women passed all the medical tests that Lovelace threw at them to test their fitness for becoming astronaut candidates, it did not take long for NASA to deny support for Lovelace's program and reject the notion of a special program to train women for spaceflight. How and why NASA in the

early 1960s refused to truly consider the possibility of a program for American female astronauts is a two-part question that deserves a more definitive answer than historians—and certainly NASA—have ever provided. What a deeper inquiry into this matter shows is that the space agency chose not to perform a serious investigation into the possibility of sending women into space during the 1960s for reasons that were largely political and cultural in nature, less so technical and certainly not medical. Leadership of the "manned" space program believed that its reasons for not considering women for use as astronauts were totally legitimate, even if it could not productively share—or at least sensibly articulate—those exact reasons with the American people.

The story of the thirteen women who underwent astronaut-related testing at the Lovelace Clinic has become relatively familiar in recent years, thanks in part to Jerrie Cobb's efforts in the 1990s to get a seat on board a Space Shuttle flight. When NASA announced in 1997 that 77-year-old senator John Glenn was being put on the crew of STS-95 as part of a study on aging, Cobb reignited her personal fight with NASA for a chance to go into space and used the Jerrie Cobb Foundation to promote that possibility.[5] Also bringing the story of the thirteen women to the public, a bit earlier, was Eileen Collins, the first female Shuttle pilot, who invited all of the surviving women from the Lovelace test group to attend her Shuttle launch in February 1995. Subsequently, a number of the women recorded their personal stories. Following up on her earlier book, *Woman into Space* (1963), in 1997 Cobb penned her autobiography, *Jerrie Cobb, Solo Pilot*. In 2001, Bernice "B" Steadman published *Tethered Mercury: A Pilot's Memoir: The Right Stuff . . . But the Wrong Sex*. Still much has been left unexplored about the proposed women-in-space program and the reasons for the American public's too often negative perception of what the women who dreamed of flying in space were really all about.

It did not take long after the birth of the space age until the idea of putting a woman into orbit began to make sense, at least to some people. Generally, women were smaller in size, weighed less, ate less, and used less oxygen. Because every pound of weight launched required three pounds of fuel, it seemed, to some, inherently cheaper and easier to launch a woman into space. Testing the basic physiological characteristics and capabilities of a select group of young women appeared to be the logical first step.

In World War II initiatives such as the Women Airforce Service Pilots

showed that women could fly airplanes in a professional manner, as hundreds of them did. The leap from piloting an airplane to piloting a spacecraft, it was therefore felt, need be no bigger for an experienced female than for an experienced male. Piloting any sort of flying machine required talent and special training, but there was no inherent reason why a talented woman pilot could not at least qualify for astronaut candidacy.

General Flickinger, when selecting candidates for his experimental program, used the records of the Civilian Aeronautics Authority to identify a group of women based on age, height, weight, medical history, and flight experience.[6] Because of her impressive flying record and growing recognition as a pilot, Flickinger selected Jerrie Cobb as one of the earliest test subjects. When ARDC cancelled the project, Flickinger transferred the responsibility for Cobb's testing directly to Randy Lovelace, believing that the Albuquerque clinic was the next best place to initiate research into whether women could qualify medically for the astronaut program. Cobb's successful completion of the battery of medical tests at the Lovelace Clinic in February 1960 persuaded Dr. Lovelace to deliver a paper on the subject of women astronauts at the Space and Naval Medicine Congress in Stockholm, Sweden, on August 19, 1960. Cobb's excellent performance on the tests also led Lovelace to extend his medical testing to other female pilots.[7]

Between January and July 1961, eighteen more women underwent testing in Albuquerque; thirteen of them, including Cobb, passed the tests.[8] Identical to the tests conducted on the Mercury astronaut candidates, with the exception of the gynecological exam, Lovelace's exams explored not only the subject's general health but also her hearing, vision, balance, stamina, and aerobic conditioning. The entire gamut took a week to complete. Because the program had neither military nor NASA funding behind it, the women had to pay for their travel, meals, and lodging. Noted aviatrix Jacqueline Cochran, a longtime friend of Randy Lovelace and a woman who had her own desires to fly in space, helped defray some of the costs.[9] The problem of expenses was compounded by the fact that the medical testing at Lovelace's clinic represented only the first portion of what was to be a three-phase astronaut qualification process. For a woman to be considered for a role in the U.S. "manned" space program, as Lovelace made clear, she would have to pass each phase of testing.[10]

Lovelace hoped that all the women who completed Phase I in Albuquerque would participate in Phase II testing, and he personally encouraged all

thirteen of them to take part. The second phase involved psychological testing at a clinic in Oklahoma City headed by Dr. Jay Shurley, a psychiatrist. The main element of the psychological testing involved surviving the ordeals of an isolation tank. Shurley put subjects in a soundproof, lightless tank in order to test the women's ability to deal with the type of isolation and sensory deprivation that astronauts would experience in space. Only three of the women—Cobb, Rhea Hurrle, and "Wally" Funk—completed Phase II. And only one of them, Cobb herself, went on to complete Phase III. The third phase involved advanced aeromedical testing at the Naval School of Aviation Medicine in Pensacola, Florida.

In making the arrangements for the three phases of testing, Lovelace had been deliberately vague and ambiguous in what he had told the women about their chances of actually being considered by NASA for entry into its astronaut corps. Since neither the military nor NASA served as official sponsors of the testing, Lovelace made all the arrangements for further testing informally.[11] Some of the women believed that Lovelace had promised them futures as astronauts if they finished the program. Examining the language that Lovelace used in his letters inviting the women to participate in the testing, one can see how easy it was to get the impression that a formal program to put women in space was already in place. In the letters, Lovelace referred to his project as the "Woman in Space Program."[12] Although he never specifically said that NASA was an official sponsor of his project, he made explicit references to the "Woman in Space Program," leaving the impression that a door to becoming an astronaut was definitely open to them.[13]

But the truth was that NASA had neither officially nor even semi-actively involved itself in Lovelace's program. The only connection that Lovelace had to NASA was through his chairmanship of NASA's Special Life Sciences Committee. Yet this connection was enough to reinforce the women's impression that their testing was formally associated with the space agency.[14] Intentional or not, the language Lovelace used with the women misled some into thinking that a space program for women was in the offing.

Media stories reinforced their belief. Even before NASA's first day in existence, October 1, 1958, newspaper articles had discussed the idea of putting women into space. One article from September 1958 envisioned a male-female team as a way of easing some of the psychological tension that astronauts would surely suffer. At a meeting of the American Psychological Association that month, a team of doctors had suggested that astronauts, in

order to counteract the "protracted isolation and boredom" of spaceflight, should enjoy "an occasional cocktail." Better yet, the doctors said, "feminine companionship" would make spaceflight less strenuous. "The spaceman is sure to retain his interest in having a female companion aboard even if liquor loses its appeal."[15] In the scientific viewpoint of the early space age, women were important only by being reduced to a component of the environment of the essential astronaut, who was male.

That same year fluid mechanics expert Dr. Arthur Kantrowitz, the 45-year-old director of the Avco Research Laboratory in Massachusetts, put forth a more responsible plan for women astronauts during a lecture at the University of Maryland Space Research and Technology Institute. In his talk the former aerodynamics researcher with the National Advisory Committee for Aeronautics (NACA), NASA's predecessor, postulated that the first person in space "could well be a woman." In his view, the weight advantage alone provided reason enough to give a woman the edge, especially if she were a qualified physician, "preferably a specialist in physiology." For Kantrowitz, it was essential that the first astronaut be a doctor "so that the human physical and mental capabilities under space travel conditions can be more accurately reported."[16] Except for that requirement, the sex of the first human in space mattered little to Kantrowitz. His notion of a woman in space reflected a certain bias, without question, but at least it did not endorse the notion of a "housewife-astronaut," which was the stereotyped image that most often appeared in popular caricatures of the woman astronaut at the time.

President Dwight D. Eisenhower possessed an even clearer vision of who the first astronauts should be, and it was a vision that, without naming them specifically, completely ruled out women as candidates. Briefly pondering the question of what sort of person would make the best astronauts, Ike and members of his administration decided that the best-qualified individuals were military test pilots, elite members of a specialized field of military aviation, one that just happened not to include women.

Eisenhower's views matched up with NASA's thinking perfectly. What NASA wanted, along with expert piloting, were the finely honed skills of technological observation that were necessary for progress in aerospace performance, solid scientific and engineering knowledge and know-how, a high tolerance for stress, and the ability to make quick and forceful decisions.[17] Although Eisenhower was determined to keep NASA separate from the military, it made sense to him that military test pilots would make the best

astronauts.[18] Recruiting them from existing ranks within the army, navy, and air force would also go a long way toward avoiding a flashy, highly publicized national recruitment process that might take months to complete.[19] Finally, relying on military test pilots would minimize the risk to human life by giving the job to those individuals who were already risking their lives in the air every day.[20]

As a consequence of lengthy discussions between T. Keith Glennen, the first NASA administrator, and Hugh Dryden, his deputy administrator, and then final approval by President Eisenhower, the Mercury astronaut selection committee required that the first class of astronauts have a total of 1,500 hours of flight time. Candidates must also be qualified *jet* test pilots.[21] Whether Eisenhower purposefully meant it to be so or not, these two basic requirements assured that no women would meet the minimum requirements, which proved efficacious to NASA when outspoken critics wrote to Washington protesting the space agency's exclusion of women. NASA did not exclude women, its spokesmen could say. There simply were no women who were qualified.[22]

A number of the thirteen women who passed Lovelace's medical tests actually did meet the minimum standard for flight time.[23] But as late as 1961, it was still only the military that offered access to jet aircraft. Jackie Cochran, the financial sponsor behind Lovelace's experiments, had, on one occasion, gotten a chance to fly a jet aircraft, thanks to her friendship with air force legend General Charles E. "Chuck" Yeager, who in 1947 became the first pilot to travel faster than sound.[24] But that experience did not "qualify" her as a jet pilot. Blocking all of the women was a classic Catch-22: Pentagon policy did not allow women to be admitted to a military test pilot school, meaning that she could not become a test pilot who flew jets. There was simply no way for her to qualify as an astronaut candidate. Not until 1972 did the Pentagon grant permission to the individual branches of the military to lift their restrictions against women in test pilot school.

To those few Americans who thought about it, none of the motives involved in American astronaut selection appeared flagrantly discriminatory to women. In September 1960, an official NASA spokesman acknowledged, "Women some day will ride spacecraft into orbit around the earth or on missions to the moon or planets."[25] But until that time, NASA was not purposefully restricting women. It was just that no women met the minimum requirements.[26]

Throughout the 1960s, each time NASA announced a call for a new astronaut class, a number of women did apply. Between 1961 and 1967 NASA selected six groups of astronauts, the first three groups all as "pilots," and, starting with the fourth group in 1964, either as "pilots" or "scientist-astronauts." Although NASA adjusted the minimum requirements for almost every new class, the chances that a woman would meet even the revised qualifications were extremely low. Each time no woman was selected, another skirmish over NASA's alleged discrimination against women broke out in the press.

To many, it continued to appear that NASA was purposefully discriminating against women in its selection of astronauts. In this highly sensitive public environment, it was difficult for NASA to defend itself by answering that, whether it was proper to label it discrimination or not, it remained that American women at the time were not working in career fields that prepared them well to be astronauts. Nor could NASA leadership, even if it knew how to articulate it thoughtfully, hope to get away with its position on women astronauts by laying the matter of discrimination on the basis of sex at the feet of broader American culture or the American military. In retrospect, perhaps it is justifiable to ask whether NASA in the 1960s could have found some way still to define the job of astronaut differently without ruling out all women, especially those who had truly extraordinary credentials as pilots. If the answer is found that there was really no way for that sort of definition to have properly gone into effect at the time, then one must wonder, what was NASA guilty of in terms of not choosing any women as astronauts?

In 1985, Joseph D. Atkinson, Jr., a former chief of the Equal Opportunity Programs Office at NASA's Johnson Space Center, published a telling book about NASA's early astronaut recruitment program that gives a clear picture of how the requirements and standards for astronaut candidates changed from the time of the Mercury program to the time of the Space Shuttle in the late 1970s. As a minimum requirement for "pilots," NASA continued to require a minimum number of hours of flight time in high-performance aircraft, experience that Jerrie Cobb and her "Fellow Lady Astronaut Trainees"—or "FLATs," as Cobb dubbed them early on—did not possess. For its second group of astronauts chosen in September 1962, NASA had lowered the maximum age from 40 to 35 years.[27] The agency did this because it realized that it took a few years before an astronaut made his first flight. Someone who was 35 when selected could be pressing 40 before he ever flew into space. Given how important it was for its astronauts to remain vital and healthy, NASA

could not afford to waste valuable time and resources on astronauts who aged into a "degraded" flight status. Two of the Original Seven's older astronauts had in fact been taken off of flight duty owing to health concerns: Deke Slayton for a heart irregularity, and Alan Shepard for Meniere's disease, a chronic inner-ear problem causing vertigo. By limiting the maximum age of candidates to 35, NASA had hoped to guarantee that its astronaut corps would stay healthy at least until after they had completed a minimum of one or two flights.

In the early 1960s, NASA had also concluded that individuals who had earned at least a bachelor's degree in engineering made the best astronauts. These spokesmen for this judgment argued that individuals who were highly skilled in research and experimental practices contributed best to NASA's advanced spaceflight systems. Every candidate selected for Group II, in fact, held engineering degrees. For Group III, NASA extended its educational requirement to include candidates with a degree in physical or biological science, but technological abilities remained paramount. This bias also proved to be a high hurdle for the inclusion of women, because so few women at the time were earning college degrees from engineering and science programs. Very few of them who did also flew airplanes.

There was no question that NASA's policies were exclusionary, and that posed an insurmountable problem for the FLATs. None of the women held degrees in science or engineering. Sarah Gorelick had earned a bachelor of science degree in mathematics, with minors in physics and chemistry, but her qualifications as a pilot, although impressive for a 28-year-old woman in 1962, did not meet NASA's standards.[28] Candidates still had to have amassed 1,500 hours of flight time as a test pilot and be involved with an experimental flight program, although NASA did now permit candidates to earn their experimental experience not just from the military but also from industry or from NASA's own flight research facilities.[29] One of NASA's Group II astronauts was, in fact, purely civilian: Elliot M. See, Jr., had flown as a test pilot for General Electric. And Neil Armstrong, although he had learned to fly as a naval aviator and had flown combat missions during the Korean Conflict of the early 1950s, was no longer in active service—or even flying in the naval reserve—when he became an astronaut in 1962. Armstrong, the future commander of *Apollo 11*, the first lunar landing in July 1969, had served from 1956 to 1962 as a civilian test pilot for NASA and its predecessor agency, the NACA.

NASA issued its third call for astronauts in June 1963. The Gemini project that provided the bridge between Mercury and Apollo was in full swing. For this candidate group, NASA made very few changes to its requirements. The most notable was the decrease in the flight-time requirement, from 1,500 to 1,000 jet pilot hours. If the candidate was currently working in an experimental flight program, this requirement was waived. But neither of these changes did anything to open up astronaut candidacy to women.[30]

The selection of Group IV in October 1964 marked the first significant change in astronaut recruitments, as NASA opened up its astronaut corps for the first time to so-called "scientist-astronauts."[31] For this new category of astronauts, flying status was still desirable but not mandated. Candidates selected who did not possess jet pilot experience were to be given one year's worth of jet flight training. NASA still held strongly to its position that the astronaut candidates must be in excellent physical condition. Although the selection committee relaxed the physical standards somewhat for the scientists, they, too, had to pass a Class I military flight-status medical exam.[32] The greatest emphasis for the new class of astronauts was professional experience in science or engineering. NASA especially liked candidates who had done doctoral-level graduate work in science, medicine, or engineering or had "comparable occupational experience."[33]

The new emphasis on science and engineering did nothing to help women become astronauts.[34] As stated earlier, very few women worked in the fields of science and engineering within the United States, and a miniscule number of them had any experience, or even ambition, in aviation. With such a very small number of young American women participating actively as professionals in technical fields, it remained almost as difficult for women to qualify for the scientist-astronaut program as it was to meet NASA's earlier pilot-astronaut standards.

It is easy to understand why NASA, on that basis, felt that it was not responsible for "excluding" women from its astronaut corps. And, in truth, it was not really any outward, conscious discrimination against women by NASA that was the problem. Given the high risks, the great unknowns, the international geopolitical significance, and the high public visibility of the space race with the Soviet Union, the agency understandably wanted, and needed, its astronaut corps to be the very best, filled with the most experienced test pilots—and later scientist-astronauts—that the nation offered. Social experimentation could not be the agency's priority when America's

success in space was critical to victory in the Cold War. As NASA and many in the rest of the country saw it, women simply did not meet the requirements. What was highly important about the scientist-astronaut initiative of 1964 for the eventual entry of women into the astronaut corps was not that the initiative enabled women to immediately become qualified as astronauts but that the initiative broadened the definition of astronaut in a way that, by the 1970s, would enable a later generation of women to meet the requirements by successfully achieving the educational levels in science and engineering that met the new NASA requirement.

NASA selected three more astronaut groups before the Apollo program ended in 1972. Group V, chosen in 1966, consisted of nineteen men, all of them "pilots," while Group VI, selected in 1967, brought eleven more men into the program, all "scientist-astronauts." Group VII, the last astronaut class prior to the Shuttle era, came to NASA in June 1969 through the U.S. Air Force Manned Orbiting Laboratory Program (MOL).[35] For these three classes, the only change that NASA made to its qualifications was to raise the age limit from 34 to 36 years.[36] Given the continuity in the minimum requirements, it is clear that NASA had grown comfortable with the quality and abilities not just of the pilots but also of the scientists coming into the program.

Although it may be unfair to criticize the early space agency for discriminating against women, one can still ask, why didn't NASA through the 1960s give the idea of putting a woman in space at least some serious consideration? Given the Kennedy administration's emphasis on the role of manned space exploration in America's prestige and propaganda battle against communism, why did American leadership choose not to show the world that an American woman could travel in space? After all, a Soviet woman, Valentina Tereshkova, orbited the globe in June 1963. The Kremlin used Tereshkova as an example to the world of the Soviet Union's sense of equality and the superiority of its women over those in the West. The success of Tereshkova's flight and the media attention that followed triggered a barrage of criticism of the U.S. space program—not just from the FLATs, but from other people as well, both men and women—for failing to give an American woman a chance to prove her mettle.[37]

The majority of the American people did not share this concern, however. All the contemporary evidence suggests that the U.S. public, to the limited extent that it even thought about the issue, was divided at best on whether it

was a good idea to put a woman in space. Generally, American men—and even a great many American women—still expected women to stay at home and raise their families. In her breakthrough 1963 book *The Feminine Mystique*, women's activist Betty Friedan (1921–2006) offered a powerful critique of the traditional social views straightjacketing American women. Cultural values embraced by both men and women had led to a "feminine mystique," a mental framework that trapped women inside their domestic roles as wives and mothers.

But other female voices of the era argued that the status of wife and mother was no trap whatsoever.[38] In dozens of magazine articles, women writers noted that American women were achieving success in the workplace while also keeping a home and family.[39] Regrettably, what many of the authors failed to express sufficiently were the tremendous difficulties most women faced when trying to balance a career and a family. A father could come home from a hard day at work and expect dinner to be waiting on the table and the children clean and ready for bed. After her day on the job, a mother would have to cook that meal, see to the children's care, and do her housework. According to historian Joanne Meyerowitz, who studied what journalists and essayists said in the 1940s and 1950s about women's place in society for her 1994 article "Beyond the Feminine Mystique: A Reassessment of Postwar Mass Culture, 1946–1958," feminine stereotypes "served as conservative reminders that all women, even publicly successful women, were to maintain traditional gender distinctions."[40] For the extraordinary women wishing to pursue opportunities as astronauts, those cultural notions worked sternly against them.

The popular American image of the astronaut from the Mercury era through the Apollo program reflected uniquely masculine characteristics. One contemporary television description of an astronaut used such terms as "vitality," "strong," and "vigorous."[41] In the magazine articles whose content about women was examined by Meyerowitz, authors typically described their subjects' femininity by remarking on a woman's "frail, willowy appearance."[42] Embedded even in those articles that applauded women who were succeeding in the workplace rested the message that American society still most appreciated feminine women, with femininity meaning, at least inferentially, physical weakness, mental inability, emotionality, and even sickness. The FLATs fought this attitude as best they could. Whenever Jerrie Cobb was interviewed, she wore a dress for the reporters and expected a question or

two about her cooking abilities and favorite recipes.[43] Despite the extraordinary talents of Cobb and the other FLATs, it was impossible for any woman, however rare and talented, to fit both American society's standard image of the astronaut and its standard image of the feminine woman.[44]

No public criticism of NASA's astronaut qualifications had surfaced until after Lovelace's project came to an end. Very few Americans knew that the program had even taken place. The first public mention came when Marion Dietrich, who had undergone testing in March 1961, just a couple weeks before Soviet cosmonaut Yuri Gagarin became the first human in space, discussed her experiences in a *McCall's* magazine article published in September 1961. Most of the publicity about the Albuquerque tests and the FLATs' subsequently persistent pursuit of astronaut candidacy came only after the navy retracted its offer to participate in Phase III. Stories critical of NASA surfaced when Jerrie Cobb and Jane Hart testified to Congress in July 1962 on sexual discrimination in the astronaut program. Although many articles supported the interests of the Lovelace women, they did not provoke any strong public reaction in favor of women becoming astronauts; in fact, much of the reaction was unsupportive of that goal. In the eyes of most Americans, being an astronaut took heroic qualities of mind and body that the normal female did not have.

One might think that the attitudes of men about their own "maleness" and about their chivalric domineering of "the weaker sex" constituted the major stumbling block, and there is no question that such ingrained gendered attitudes posed a real problem. In an article entitled "Women Astronauts" published in *Space World* in September 1961, author Donald Cox wrote, "The biggest initial obstacle to an accelerated 'astronette' program still to be overcome is the cultural bias of American men against exposing their women to the hazards of spaceflight."[45] A much different article from the period, one that described Jerrie Cobb's Phase I testing in Albuquerque, delivered a narrow-minded, farcical attack on the whole idea of women going into space. "Most men feel imprisoned when they're in a barbershop chair," the anonymous author wrote. Women, on the other hand, "spend apparently blissful afternoons under the hair drier, nipping at the *Ladies' Home Journal* and dissecting personalities with the other girls. . . . Any organism so placid and so easily amused should thrive on a mere 250,000-mile trip."[46] Other than that, the journalist judged that nothing about the female personality translated well into being a space traveler. The astronette "would probably

use her insidious influence to get softer cushions in the rocket ship, more room on the inside, curtains over the portholes, antimacassars, throw rugs and pastel walls."[47] The only sensible solution, according to the misanthrope, was to "leave women at home until men had time to prepare the raw ground, as they did at the frontiers of earth."[48]

Although most readers would have believed the anonymous author to have been a man, it was possible, given the attitudes of the time, that the writer was a woman. Into the 1970s, if not beyond, many women, particularly middle- and upper-class women, looked at the world from within the traditional cultural framework that distinguished between proper male and female roles. Until that mentality changed in fundamental ways, neither men nor many women would come out as strong advocates of women becoming astronauts.

The special hearing in Congress on NASA's alleged discrimination against women becoming astronauts stimulated some newspapers to query their readers on how they felt about the issue. Results indicated mixed feelings. The *Boston Herald*, in its August 27, 1962, edition, published quotes from six people—three men and three women—responding to the question, "Should there be women astronauts?" One of the male respondents, Leo O'Hara, seemed to like the idea: "It's unfortunate the Russians seem to be ahead of us in this. With more [rocket] thrust like the Russians have now we could get more women in orbit." But O'Hara then joked, "They [women] have been going around in circles for years anyway."[49] Charles Scott's answer gave somewhat stronger support to the idea of women in space: "I don't see why not. They're supposed to be the weaker sex, but I don't see any real evidence of that." Joe Ceraso put less faith in the abilities of women: "That's a tough question. If the women were screened properly I think some would be found who could do it. I don't think the average woman has the stamina. On the average a man would come much closer to do what is required than a woman would."[50] Two of the three women favored the idea. Mary Stafford, a nurse, felt that women had "qualities that men don't have and could make a real contribution to the space age."[51] In contrast, Adele Durell, the only full-time housewife whose interview the paper published, expressed disdain for those women who pushed to go into space: "I don't see any reason why there should be [women astronauts]. There are enough men in the armed forces to take care of that. I think the women are silly who make a fuss about it. It's

ridiculous. When you get right down to it I don't even see why women should be in the service."[52]

Ironically, Jackie Cochran, who had paid for most of the women to take the tests at the Lovelace Clinic, issued the most forceful denunciation of the idea of accepting women candidates for the Mercury space program. Cochran had a history of only supporting projects that benefited her personally. She felt herself the most qualified to be the first woman in space,[53] but her advancing age (she was 56) and declining health made her selection impossible. In her testimony before Congress, Cochran blindsided her fellow women pilots (Cobb and Hart also testified) by asserting, "I do not believe there has been any intentional or actual discrimination against women in the astronaut program to date." Inclusion of women in the space program "should not depend on the question of sex but on whether it will speed up, slow down, make more expensive or complicate the schedule of exploratory space flights."[54] Medical testing did not yet offer sufficient evidence on how women and men compared physiologically and psychologically.[55] If politicians pushed for a women's space initiative, Cochran warned, Congress had better be prepared to absorb significant additional cost, because many of the women beginning astronaut training would never finish it. Based on her experience as head of the WASP during World War II, she predicted that 40 percent of the women would drop out owing to marriage and pregnancy.[56] In response to Cochran's remarks, Representative James G. Fulton (R-Pennsylvania), one of the strongest backers of having a woman astronaut, declared that all the male astronauts in 1962 had children, some of them quite young, and those children were assets in their lives, not problems. Cochran retorted, "It would not be an asset while you were having the babies."[57] The effects of Cochran's appearance before the special congressional committee deflated any hope that the federal government would mandate a change in NASA's astronaut qualifications opening the door to women.

Various leaders of the space agency, including a few astronauts, did their best to respond thoughtfully to those critics who felt that NASA should be opening its astronaut corps to women. One of them was Dr. George Low, the director of spacecraft and flight missions at NASA Headquarters, who also appeared before the special congressional committee.[58] A trained engineer who had done aeronautical research with the NACA in the 1950s, Low tried to answer the questions he was asked with what he considered to be straight

facts. The "fact" was that astronaut requirements were such that no women yet qualified. Further, modifying the national plan to include putting a woman in space, Low thought, would greatly slow progress toward putting a man on the Moon by the end of the decade, the bold goal that President Kennedy had established.[59] To many Americans, however, Low's statements sounded eminently reasonable.

Mercury astronauts John Glenn and Scott Carpenter reinforced Low's view. In the comments they issued, however, they offered that it was only a matter of time before some women would qualify to train as astronauts. In the meantime, it was critically important for NASA to carry out the early phases of space exploration with the best-qualified people. So little was known about the stresses of spaceflight, it only made sense to select the first astronauts from test pilots who had, in Carpenter's words, "demonstrated that they have certain capabilities and have been employed in the field that most closely approached space flight."[60]

Interestingly, astronaut John Glenn, a future Democratic U.S. senator from Ohio, felt that the fact that no women yet qualified for astronaut selection indicated that "there may be something wrong with the social order."[61] Glenn continued, "Men go out and fight the wars, fly the planes, come back and build them. We haven't seen the idea of women in space put forward because they're better qualified. Nobody [has] put them forward as [being] better qualified, but just because they're women."[62]

Glenn's recognition was critical. America of 1962 still clung to very powerful stereotypes about what types of jobs and roles in society a man and a woman should and should not pursue. Reiterating what George Low and Scott Carpenter told the subcommittee, Glenn compared the FLATs' success during the Lovelace testing to a preseason physical exam given by the National Football League's Washington Redskins. "My mother could probably pass that," Glenn said, "but I doubt that she'd play in many games."[63] In his view, the testing in Albuquerque demonstrated only that some women met a medical baseline, not that they could actually do the job.

None of the individuals who testified before Congress in 1962 said that women could never be astronauts. Even Jackie Cochran believed that a woman-in-space program was not too far down the road, and she strongly encouraged the idea if it was done "intelligently" and "properly."[64] But trying to do it in the midst of an urgent space race, one whose goal was landing on the Moon before the end of the decade, did not make sense to her—or for the nation.

In September 1962, NASA announced its second group of astronauts, the class of astronauts that would fill most of the slots for the upcoming Gemini and Apollo projects. The first Gemini flight was expected to launch in late 1963.[65] Gemini's goals of orbital rendezvous and docking, extravehicular activity (EVA) or "spacewalking," and long-duration spaceflight had to be achieved quickly if Gemini was to provide effective technological building blocks for the Apollo Moon landing program. NASA projected that by early 1967 it would be ready to attempt a circumlunar flight.[66] Given the demands of this compressed schedule, it was hardly unreasonable for NASA leadership to believe that a woman-in-space initiative was a distraction that the nation could not afford.

NASA administrators felt significant pressure to succeed.[67] A highly effective selection of astronauts who could excel in their jobs was absolutely vital to the success of the space program. Robert R. Gilruth, the director of the Manned Spacecraft Center in Houston (later named the Johnson Space Center in honor of President Lyndon B. Johnson), replied to a letter written by Jerrie Cobb in which he tried to explain the basic position in which NASA found itself: "The manned space flight program is a serious scientific endeavor and we cannot include any but the best-qualified personnel in our flight teams. . . . We are in competition with the Soviets, not for the accomplishment of propaganda stunts, but for the acquisition of sound technical and scientific information on the problems of human space flight."[68]

There was no question that Gilruth believed in the correctness of his position independent of any personal or institutional bias against women: "I feel that we must conserve our efforts and concentrate on problems of a more pressing nature without introducing additional variables into our equation from either a scientific or public-relations standpoint."[69] Putting a woman into space, even if the Soviets were planning to do it themselves, simply could not be a priority. The space race was serious business and, as such, NASA had to put all of its efforts into getting the job done. If that meant women could not yet be astronauts, so be it.

For Gilruth and most other officials of NASA's manned space program, the issue of personal risk was not a primary factor in the arguments they used about why women could not yet train to be astronauts. Indeed, spaceflight risked the lives of astronauts, and many Americans still felt that women should be spared from such hazardous duties, in the civilian space program or in the U.S. military.[70] But in Gilruth's view, national priorities were enough to

explain why NASA could not be training what it deemed to be unqualified applicants. Gilruth did not water down that rationale by throwing in the matter of not wanting to risk women's lives.

In the context of the early 1960s, perhaps the strongest argument made by the advocates for women becoming astronauts was the fact that the Soviets were training women for spaceflight. Flying a woman in space had tremendous propaganda value for the Soviets as they tried to convince the rest of the world that the social and sexual egalitarianism of the communist system was inherently superior to the misplaced, exploitative values of the decadent, capitalist West. Lovelace Clinic test veteran Jane Hart played this "space race card" herself when she petitioned members of Congress for a woman-in-space program in March 1962. Hart reported that there was "considerable evidence" indicating that the Soviets were training women as cosmonauts: "It is my belief that the Russians will have successfully space flown a woman by next September."[71]

While privately acknowledging that the flight of a woman cosmonaut would make good propaganda for the Soviets, NASA leaders believed that winning the space race by getting ahead of the Russian program generally, and especially beating the U.S.S.R. to the Moon, was ultimately the best way to show the superiority of "the American Way." To accomplish that primary goal, according to a column written in March 1962 by journalist William White, the emphasis had to be "a sound, slow job in fundamentals, all the fundamentals."[72] "The public," White opined, "requires education in the basic fact that this is an immensely serious and adult business in which there is only one real possibility that we shall 'lose.' "[73]

While NASA risked alienating some of the American people for maintaining astronaut standards that ruled out women, on the whole the country understood NASA's rationale and accepted what needed to be done. By including women as astronauts, NASA would risk much more politically than isolated criticism from feminist spokespersons. The agency's existence depended entirely on federal money. NASA leaders understood that meeting the country's primary expectations for its space program was much more important than accommodating a social agenda that seemed to be a serious concern to only a small minority of the American people.

This rationale did nothing to appease those women who were intent on getting a chance to fly in space. In fact, their persistence grew, as did the

number of young women who wanted to join the astronaut ranks. In June 1963 the Soviet Union did launch the first woman into space. Valentina Tereshkova completed forty-eight orbits around the Earth during a mission lasting almost three days. News of her flight incensed the FLATs, a fact that did not escape the national media. Following Tereshkova's achievement, the *Washington Post* reported that NASA Administrator James Webb, the "hard-working, harassed head of the National Space Agency," was "now getting browbeaten by the ladies."[74] Referring to the FLATs, noted columnist Drew Pearson wrote, "The U.S. lady pilots are boiling mad that Jimmy Webb turned them down."[75]

Exacerbating their disappointment was the fact that, back in May 1961, Webb had appointed Jerrie Cobb as NASA's consultant on women in space. Cobb later described her role as that of "the most unconsulted consultant in any government agency."[76] At every opportunity, Cobb and the FLATs in support of Cobb's role spoke out on the issue, hoping to raise the public consciousness about what they came to feel even more strongly was NASA's discrimination against women pilots.

A close look at the Soviet attitude toward women in space would have shown that it was hardly enlightened. In evaluating the Soviet achievement of putting the first woman in space, one must understand that the ideological context for achieving "the first" overrode all other considerations. By launching Tereshkova aboard *Vostok 6*, the Soviet space program accomplished two feats, only one of which was primarily conceived for its propaganda value. Tereshkova's flight, indeed, gave the Soviet Union another space "first," which Premier Nikita Khrushchev hammered upon internationally as another indicator of the superiority of communism and the Soviet system. But, also by launching Tereshkova in the one-person *Vostok* spacecraft, the hands-on managers of the Soviet "manned" (the Russian word was also expressed in the masculine gender) space program avoided the trouble that could come when putting a man and a woman together in such an intimate working environment. Not that Soviet society as a whole viewed a man-woman spaceflight as especially problematic, but by segregating the women cosmonauts into a separate training group and by launching Tereshkova singularly and alone in her spacecraft, the whole issue of integrating men and women into a team of astronauts—something that the Soviet program was not really interested in doing—could be avoided. In the American space program, such segregation of

women astronauts and isolation of their missions would not have been acceptable. In the American context, bringing women into the program meant integrating women and men into one astronaut corps, an altogether more difficult and problematic proposition than what the Soviets had done or, at that point, were planning to do.

Even in the midst of reports of Tereshkova's training for her space flight, the idea of sending a woman into space as part of the American program garnered widespread criticism in the American press. One columnist, Robert Ruark of the *Washington Daily News*, seemed to be supporting women astronauts in August 1962 when, in fact, he made farce of the idea: "Most of the women with whom I have driven in automobiles would make admirable test pilots of anything, since each sally-forth is a fresh adventure."[77] "As for engineering," Ruark continued, "anything a woman can't fix with a hairpin is unfixable by a corps of engineers."[78] Concluding his damning by faint praise, he smirked, "Strike the shackles from our women, cry I, and cut them loose in space! It might even serve to free them from the Martini lunch and encourage them, after the novelty has worn off, to return to the kitchen."[79]

Not all the women who wanted to go had the same reasons for wanting to become astronauts, but they shared certain assumptions. Following the introduction of the first class of scientist-astronauts in 1965, which included no women, one could have expected criticism of NASA to intensify, but such was not the case. Mary Ann Noah, the winner of the 1964 Powder Puff Derby (an air race open only to women fliers), confessed, "I hate to be a traitor to my sex, but I do think men can go it alone. . . . Space flights should be left up to the men for the time being."[80] Cattie Lou Miller, commissioner of public information for the state of Kentucky, observed, "I've always thought [of technology] as a field for men, anyway, and I've never given a thought to women invading it."[81] New England socialite Eleanor Lally, whose opinions were reported in the *Boston Globe* in April 1965, felt she had no time to waste on a frivolous trip to space: "I've got sufficient to do down here. Now honestly, you'd think, to hear them talk, that we women should feel discriminated against. I don't feel discriminated against. I just feel indifferent. If I were an escapist, maybe I'd want to go to outer space, too, but really I'm just too busy. So let them have it."[82] In accord with Lally, Judith Thompson asked, "Why should some darn fool woman want to shoot herself to the moon?"[83] Another voice, belonging to a "Miss Irma Reynolds," was so incensed by the

FLATs' actions that she wrote a letter to James Webb at NASA supporting any plan to bar women from space: "Keep the women out of the space flights. The damn crazy things. They would cause you a lot of trouble and expect special consideration and favors. The hell with them."[84]

At work were well-taught social prejudices on the proper ambitions, desires, and behaviors of women. Mary Aikens, Mary Ann Noah's copilot for the Powder Puff Derby, made a highly illuminating observation in 1965, when she said, "This country feels protective toward women and leaves it to the men to do the pioneering."[85] Other critics questioned the women's motivations for becoming astronauts and asked whether any woman was really prepared to handle the extreme conditions. Dorothy Roe, a staff member of the *Orlando Sentinel*, reported that men could handle being dirty, not having a change of clothes or a chance to shave, and living with other men in a spacecraft. Women, she argued, only a little tongue in cheek, would not want to rough it: "The first thing a girl astronaut would think of, naturally, is a good supply of perfume and deodorants. Some air freshener might come in handy, also."[86] No woman could survive on board a spacecraft without shampoo, moisturizers, dry cleaning products, and cosmetics. Roe asked, "And how will a girl keep her hair curled in outer space?"[87] Like many other Americans, Roe could not picture any woman of the 1960s going into space who did not match the fundamental female stereotype.

Into the 1970s, Americans seriously questioned whether women should fly in space. The strong consensus was that women were not yet ready for that role and that the goals of the national space program were too important and urgent to try anything that might turn out to be ineffectual or cost additional resources. As John Glenn had implied, a transformed social order might make it possible someday for women to be astronauts, but that time had not yet come. Others felt that women would never be ready and should quit fussing about it.

The decade of the 1970s did bring social and political movements, new technologies, new government legislation, and new pressures for women to be more fully integrated, in meaningful ways, into the country's professions —including its elite astronaut corps. No single historical event related to NASA or the space program made this a reality; rather, it happened gradually as a result of underlying social, political, and economic changes taking place in America as a whole.

Still, the path to women in space would remain bedeviled with traps and ogres of various kinds. Even once NASA began to promote greater participation by women (including women of color and ethnic minorities of both sexes) in traditionally all-white, all-male positions—a significant step forward—that would enable women for the first time to meet the basic requirements for astronaut selection, a den of administrative, bureaucratic, organizational, logistical, and technological dragons continued to rear their ugly heads, breathing smoke if not fire over the issue of getting women into space.

CHAPTER 4

Making Space

NASA designed its post-Apollo vehicle, the Space Shuttle, to make access to space routine. Its idea was to create "an integrated, efficient, economical space capability consisting of permanent space station modules and a low unit-mission cost space transportation system that will make earth-moon space easily and economically accessible to man."[1] The agency sold the idea of the Shuttle as a "space truck," a craft to haul people and cargo back and forth into space not just for NASA, but also for the Department of Defense, other government agencies, commercial users, as well as foreign nations.[2] In accord with a changing NASA approach to public affairs, the Space Shuttle also brought with it the first real opportunity for women to fly in space.

By the mid-1960s when NASA officials began thinking about a combined Space Shuttle/Space Station concept as one of the foundations of America's long-term goals in space, consideration of the idea of women flying in space became much more reasonable than it had been during the scramble to get to the Moon. Into President Lyndon Johnson's administration, NASA's budget remained relatively strong.[3] Public excitement about the race to the Moon kept NASA in the spotlight.[4] There was every reason to hope that the country would support "the next logical step" in space, whatever NASA deemed it to be.

As had been envisioned by Wernher von Braun and other space visionaries of the 1950s, that "next logical step" was a space station that would serve as a staging platform for regular flights to the Moon and to other parts of the solar system.[5] Those missions would require much longer stays in space for the astronauts. As already discussed, psychologists as early as 1958 had suggested that including women on board these longer flights might be the best way to protect against "protracted isolation and boredom" for male crew members.[6] By the late 1960s, advocates of women in space offered a more

sophisticated perspective on the contributions women could make to American spaceflight.

At a meeting of the American Institute of Aeronautics and Astronautics (AIAA) in March 1968, U.S. Air Force research scientist E. G. Johnson led a discussion about women in space. "Who knows?" Johnson offered. "An all-female crew might be the best to go to Mars."[7] Although most still found problems with mixing crews, some experts were at least talking about it. The AIAA discussion in the late 1960s centered mostly on the general differences between men and women that might interfere with a mission. Johnson himself commented, "There's just too much difference between men and women. We really don't speak the same language. Imagine putting them together for that long. We'd be creating a communications problem that could be avoided."[8] Walt Stranahand, a guidance and control specialist for NASA, added, "They may well be the best crews—all women as opposed to men. Actually, there's a scientific need to know [how women could perform]. A woman's psychological and physical makeup may be best suited for such flights."[9] Yet insecurities about sexual matters persisted. Walton Jones, who worked in the office of life sciences at NASA, made the most blatant comment: "They'd certainly complicate things because there's quite a moral question involved that would have to be overcome. For instance, you're almost going to have to have separate facilities. Our spaceships just haven't been built for a mixture."[10] If women were to be involved, the new Space Station and Shuttle designs would have to be designed to accommodate sex- and gender-related matters that the exclusively male AIAA speakers found innately troublesome.

As planning for the Space Shuttle and Space Station began, no one at NASA specifically stated that American space exploration would be beginning a new phase in which women would participate as astronauts. But media coverage suggested that NASA's next big space project would likely have room for women as crew members.

As early as 1964, a year before NASA began launching its manned Gemini missions in preparation for the Apollo program, agency insiders suggested that the future of American spaceflight included women astronauts. John "Shorty" Powers, NASA spokesman and the "Voice of the Astronauts" during the Mercury era, wrote the *Space Talk* column for the *Houston Chronicle*. In answer to the question "Is a woman astronaut qualified to perform every necessary function that a man can in outer space?" Powers replied, "I have no

doubt but that she could perform every bit as well—and, according to my wife, probably better than our male astronauts. I think certainly we will yet see American girl astronauts flying in space."[11] Astronaut Neil Armstrong, who would not make his first spaceflight until *Gemini VIII* in March 1966, predicted in July 1964, "Some day we will have qualified women and I'm sure they'll be included in the program."[12] Even John Glenn, who had testified against the FLATs joining the astronaut corps in 1962, anticipated that women would fly in space, perhaps even as part of Apollo. The first American to orbit the Earth acknowledged that the new scientist-astronaut program should "offer a serious chance for space women."[13] The idea that NASA might be poised to consider selecting women for the astronaut corps seemed ready to crystallize.

NASA began to talk seriously about its plans for the future of American spaceflight even before *Apollo 11* made the historic first Moon landing in July 1969. That March, in the journal *Astronautics and Aeronautics*, Dr. George Mueller, associate administrator for the Office of Manned Space Flight, published an article on the Shuttle and Space Station that NASA felt could be beginning operations by the mid-1970s. A drawing of one possible design for the Shuttle depicted twelve crew members on board, four times the number of astronauts that either the United States or the U.S.S.R. had ever launched.[14] A subsequent newspaper story indicated that the larger crew size meant that women would likely have the chance to fly. Although acknowledging that "NASA hasn't said so specifically," the reporter had uncovered that "one of the aerospace companies designing the piggyback spacecraft shows the Shuttle transporting women scientists to space stations in earth orbit."[15] The journalist added, "Space stations, still on the drawing board, will be roomy enough to accommodate dozens of residents, *with privacy for all*" (author's emphasis).[16] Without some provisions made for privacy, naturally, a large part of the American public would keep its qualms about men and women mixing company in space. That some industrial contractors were already creating spacecraft designs that provided space for both men and women clearly suggested, however, that NASA itself was ready to take a step toward integration of the astronaut corps.

NASA's plan to build a spacecraft capable of accommodating a mixed-sex crew reflected the era's changing social mores and attitudes. In the sixties, the civil rights movement had incited and transformed communities across the nation, as followers of Dr. Martin Luther King, Jr., leader of the Southern

Christian Leadership Conference (SCLC), and members of the Student Nonviolent Coordinating Committee (SNCC) fought for equality for African Americans. "Race riots" had broken out in the Watts area of Los Angeles, resulting in thirty-four deaths.[17] Similar riots erupted in Newark, San Francisco, Cleveland, Milwaukee, Chicago, and Dayton.[18] While institutions and individuals in southern states strained to sustain what amounted to the country's most egregious racial discrimination, segregation in the schools of fifteen large northern cities increased significantly between 1950 and 1965, despite the landmark court decision *Brown v. Board of Education of Topeka* laid down by the U.S. Supreme Court in 1954.[19]

With the battle over racial equality being so hotly contested, the best strategy in the fight for women's rights in America seemed to lay in riding the momentum created by the civil rights movement. When Congress passed the Civil Rights Act of 1964, Title VII of the bill made illegal any employment discrimination on the basis of sex as well as race.[20] When the Equal Employment Opportunity Commission (EEOC, the regulatory office founded as part of Title VII to ensure that the law was followed) opened in 1965, over a third of the complaints received by the commission came from women claiming sex discrimination.[21] But as the only female commissioner on the five-person EEOC, Aileen Hernandez, remembers, "The message came through clearly that the Commission's priority was race discrimination and apparently only as it related to Black *men*" (italics in original).[22] Remarks made by an airline executive during this time, quoted in the *Wall Street Journal*, made clear just how deeply American men feared any such fundamental change in the social hierarchy of the professions: "We're not worried about the racial discrimination ban. What's unnerving us is the section on sex. . . . What are we going to do now when a gal walks into our office, demands a job as an airline pilot and has the credentials to qualify?"[23]

On the surface, America's space agency seemed largely untouched by the social and cultural turmoil of the period. A snapshot of Mission Control during the Apollo era captured a landscape of white, male scientists and engineers with crew cuts, neck ties, pocket protectors, and slide rules. These men tended to live traditional and conservative lifestyles. But not even NASA operated in a vacuum. As historian Terry H. Anderson has written in his book *The Sixties*, "The nation's two most pressing problems [race and war] forced citizens to make decisions about the course of the nation, even about their culture, because at the same time a youthful counterculture emerged to

confront the values of mainstream society."[24] Those changing values, which were also taking place in and around the families of all NASA employees, influenced how society viewed women and their public roles.

Few Americans took Title VII's sex discrimination ban very seriously; what was more, as a federal agency, NASA was actually exempt from the law. But the documentary record involving NASA's efforts to encourage the employment of both women and racial minorities in the second half of the 1960s suggests that NASA officials understood and respected the importance of Title VII.

On March 31, 1966, NASA administrator James Webb issued an agency-wide policy directive on equal employment opportunities for women. Four and a half years earlier, John Kennedy had established the President's Commission on the Status of Women via Executive Order 10980, and Administrator Webb followed suit: "It is my intention to take positive steps to ensure equal opportunity for employment and advancement for all qualified persons on the sole basis of merit and fitness and without discrimination on the basis of sex." Webb expected NASA employees "at all organizational levels to give full support and cooperation to this problem."[25] By early that summer, Webb had laid out clear policy and instructions for equal employment and designated an equal opportunity officer for NASA. His June 1966 document stipulated, "It is the policy of NASA to promote and insure equal opportunity for all qualified persons, without regard to race, creed, color, national origin, politics, marital status, physical handicap, or sex, employed or seeking employment with NASA."[26]

Sweeping cultural change cannot simply be dictated by such policy, yet the significance of Webb's actions on behalf of equal employment at NASA should not be downplayed. The policy enacted by Webb exceeded the federal law's requirements of the agency. When President Johnson issued Executive Order 11246 in September 1965, which ordered the federal government to prohibit discrimination in the workplace, the order still only protected against discrimination by "race, creed, color, or national origin."[27] Not until 1967 would Johnson amend his order to include "sex."[28] For Webb to move for protection against discrimination inside NASA based on politics, marital status, physical handicap (against which the federal government did not mandate protection until 1990), and sex showed remarkable open-mindedness and forward-thinking, a reflection of the fact that Jim Webb was an extraordinary man and career federal bureaucrat.[29]

From the late 1960s, the Manned Spacecraft Center[30] (MSC) in Houston worked to accommodate the employment directives coming down from the administrator. Robert Gilruth, the director of MSC from its inception in 1962 until his retirement after the last Apollo mission in December 1972, took Webb's new policies seriously. In January 1969, Gilruth established the position of Deputy Employment Opportunity Officer for MSC. By August, he named Joseph Thibodaux, Jr., as the center's EEO counselor.[31] Gilruth also designated H. Mervin Hughes as the coordinator for the Federal Women's Program.[32] Over the next two years, the MSC director continued to emphasize the importance of the EEO office through the distribution of "Management Instructions" and the naming of more people to the growing body of EEO counselors at the center.[33]

Nowhere in the relevant NASA documentation did NASA management in either Washington, D.C., or Houston ever excuse the astronaut office from making the same efforts to address equal rights and equal employment opportunities. Aside from the fact that astronauts still had to meet the physical requirements and that the tasks of each spaceflight mission would directly influence if not determine the judgment as to who would best serve on board a particular flight, nothing administratively within NASA now stood in the way of qualified women entering the astronaut corps.

Along with this active executive encouragement for all American institutions to respect the rights of women, an additional major federal policy change soon opened the window of opportunity for the employment of women even wider. On March 24, 1972, Congress enacted the Equal Employment Opportunity Amendment to the Civil Rights Act of 1964, which reaffirmed and shored up the nondiscrimination laws in the federal government.[34] The amendment also permitted the EEOC to handle lawsuits for complainants of unfair employment practices based on sex. Of all the federal policies enacted as part of the women's rights movement, the 1972 amendment stated most clearly that the government would no longer overlook sexual discrimination in the workplace.

Not everyone felt that NASA was keeping up with the times—or believed that the space agency was actually part of leading the charge. In 1978, a woman by the name of Sharon E. Macha wrote to the *Houston Post* chastising one of America's first female astronaut candidates for not giving more recognition to the 1964 Civil Rights Act and to the women's movement as the key to NASA's willingness to open the astronaut corps to her and other women.[35]

What Macha failed to realize was that as an organization NASA had already moved forward rather aggressively on the question of equal employment rights for women, in all its professions, well before the federal government and the strength of the women's movement had much to say about the issue. NASA acknowledged the work of its female employees—and promoted the contributions they made to space science and exploration—largely through stories in its individual centers' newsletters and internal publications. One of the agency's most famous women during the 1960s was Dr. Nancy Grace Roman. Born in 1925 in Nashville, Tennessee, Nancy Grace was the only daughter of music teacher Georgia Smith Roman and geophysicist Irwin Roman. After earning her bachelor of arts from Swarthmore College in 1946 and her PhD in astronomy from the University of Chicago in 1949, she joined the radio astronomy program at the Naval Research Laboratory (NRL) in Washington, D.C. When the staff and facilities of NRL's Vanguard satellite program were transferred to NASA shortly after the establishment of the space agency in 1958, Dr. Roman became a NASA scientist and transferred to the agency's new facility in suburban Maryland, Goddard Space Flight Center. There she served as the first chief of astronomy in the Office of Space Science—and, as such, was the first female to hold an executive position in NASA.

Early on, NASA issued a great deal of publicity about her work because, as Dr. Roman remembers, "the women's pages were so very anxious to get material."[36] As a result, she became a primary resource for other women interested in careers in space. Roman delivered public talks on the roles of women at NASA and corresponded regularly with other professionals on the topic.[37] More importantly to the growth of female numbers in the sciences, she mentored young women interested in working for NASA. In a letter to one female high school student, Roman lamented, "Relatively few women choose the scientific and technical occupations which are the necessary background for an astronaut. This, in turn, probably results from their early guidance: a boy gets toys to take apart and put together again; a girl gets dolls. I hope that interest such as yours indicates that more women are becoming interested in technical subjects. The training is long and arduous, but the rewards make it worthwhile if the field really interests you."[38] As a woman scientist serving in a high-ranking position at a NASA facility, Nancy Grace Roman served as an important role model of female achievement. During her career, she held major responsibilities for the design and operation of several

astronomical satellites, including the Cosmic Background Explorer and the Hubble Space Telescope. Throughout her distinguished career, she received many awards, including honorary degrees from Russell Sage College, Hood College, Bates College, and Swarthmore College. She also had an asteroid named in her honor: 2516 Roman.[39]

By no means was Dr. Roman alone as a woman of consequence at NASA. More apparent in the public face of NASA was Dr. Carolyn Leach Huntoon, who came to work at NASA in 1968, following graduation from the Baylor University College of Medicine, to work on the medical team responsible for the health and well-being of the astronauts.

At Baylor, Huntoon had done pioneering research on astronaut metabolisms under the supervision of a professor under contract to NASA studying the levels of stress being experienced by astronauts as they prepared for and following spaceflight missions.[40] With funding from a National Research Council postdoctoral fellowship, and as the principal investigator, Dr. Huntoon set up a lab at MSC for pathology and metabolism studies on the Apollo astronauts.[41] When asked about the environment for a woman in this laboratory setting, she relates today, "The interesting thing at the time was I felt nothing was holding me back. And I would add that nothing was holding anyone back who wanted to work. The work was there to be done, the money was there to fund the equipment, and no one was saying don't do it. So it was a wonderful environment."[42]

Although recognizing that the number of women working in science and engineering in Houston or elsewhere was small, Huntoon feels today, as she did at the time, that "it wasn't because no one wanted to hire women. It was because there weren't [many to hire]. . . . So you just hired the next [good] person that was [available]. If it happened to be a woman, fine. But most of the time it didn't."[43] Prior to the 1972 EEO Amendment, there was no federal mandate requiring universities to provide equal opportunity for women students in the classroom. Public universities only seriously initiated recruitment programs for women interested in science and engineering after Congress passed the amendment. Until then, the flow of women in or out of science and engineering education was too minor to even merit calling it a pipeline. Huntoon's perceptions suggest, at a minimum, that MSC held no bias against hiring qualified women, or, beyond that, that the leadership at MSC was trying hard to follow through on Administrator Webb's policy against sexual discrimination in the workplace.

While Nancy Grace Roman and Carolyn Leach Huntoon worked largely behind the scenes, two women promoted and highlighted by NASA for their contributions operated much closer to the public center of America's space program. Frances Marian "Poppy" Northcutt (b. 1943) and Margorie Rhodes Townsend (b. 1930) were the subjects of several news articles published in 1970 featuring how women were contributing more and more to U.S. space efforts. Northcutt worked at TRW as a computer consultant for NASA. Seated in Mission Control during the nearly tragic flight of *Apollo 13* in April 1970, Northcutt was responsible for the computer programs used to calculate the limping command module's trajectory back to Earth.[44] On December 12, 1970, Townsend, an engineer at Goddard Space Flight Center, became the first woman to oversee a satellite launch when serving as the project director for the launch of Explorer 42, a 315-pound satellite that used X-rays to map sections of the universe.[45]

A marked difference between these two women's experiences surfaced in the articles. Although the article on Poppy Northcutt described her as a woman with all the feminine charms of a popular—and wholesome looking and behaving—American television actress of the era, Donna Reed, Northcutt indicated that her working relationships with men operated more times than not on rather level ground: "Sometimes they treat me like a girl and sometimes like an engineer, but always with friendliness and consideration."[46] Margorie Townsend met greater challenges from the men in her workplace. The launch of Explorer 42 that she directed in 1970 took place on a converted oil platform 3 miles off the coast of Kenya in the Indian Ocean and involved a team of forty Americans and one hundred Italians, essentially all of them men. One Italian crew member remarked on having a female director for the launch, "They'll never understand this at home." "They don't like it," Townsend acknowledged at the time, "but they tolerate me."[47] The published profiles of Northcutt and Townsend offered readers conflicting images of working womanhood at NASA, indeed, but they also revealed—at least in retrospect—the value the space agency was coming to place on the contributions of professional women.

That the space agency hallmarked the work of a handful of outstanding women hardly proves that NASA as an organization was progressive in its thinking about women in the workplace. The experiences of some women, and even some aspects of the careers of the women mentioned above, strongly suggest otherwise. Carolyn Huntoon recalls that sometimes she was left out

by the men she worked with: "Throughout the Apollo and *Skylab* era, the big thing that everyone always laughed about was that all the guys that were investigators at my level or lower were all taken out to the recovery ship when the astronauts landed in the ocean, but they never let me go." Some women were on board those ships, but NASA would never let her go. "Women news people were permitted on board, but not me. I had to send my technicians."[48]

In other words, no matter what NASA's official positions were on equal employment for women, and no matter what directives came from on high, the men who worked at NASA continued to hold the same notions about rights, privileges, duties, and gender as did the rest of the American public. Whether they were engineers, scientists, technicians, managers, or astronauts, NASA's personnel, still predominantly male, nonetheless grew up under mothers who mostly stayed at home while their fathers went out to earn a living, and they married wives from whom they anticipated—rather, expected—the same. The culture at NASA could only fundamentally change at a rate consistent with that taking place in society as a whole, which in most quarters was taking its time to adjust to the new era of women's liberation.

Until Congress passed the EEO Amendment, the opportunities for women as astronauts seemed to many people to be just talk. NASA's Group VI scientist-astronauts, selected in September 1967, *could* have included women, from a purely bureaucratic perspective, if women had qualified and talented enough women had applied.[49] In truth, NASA did not do much, either publically or privately, to encourage women to apply for the astronaut corps, at least not until the agency released its call for applications in July 1976.[50] With the future of its budgets in doubt because of heightening public concern over the war in Vietnam and social problems at home, along with a generally growing disinterest in the activities of the space program, pushing to make spaceflight available for women seemed politically risky. Even though the Space Act of 1958 had established NASA as a source of scientific and technical research, the politics of space had always played a major part in almost everything the agency ever did or said.

As a federal agency dependent—as all federal agencies were—on tax dollars, NASA very often was forced to make policy decisions based not on its own goals and priorities, but on the actions and attitudes of others. The development of the Space Shuttle provides a good case in point. In 1970, a year after Richard M. Nixon entered the White House, the Office of Management and Budget (OMB) made it clear to NASA that there would not be

enough money to support the Space Station and the Shuttle simultaneously.[51] According to political scientist John Logsdon's 1986 article, "The Decision to Develop the Space Shuttle," NASA understood that the agency was more likely to get congressional and presidential approval for the Shuttle but not for the Space Station as well.[52] At lower cost, and as a reusable system, the Shuttle not only offered a launch vehicle for NASA, the Department of Defense, commercial users, foreign clients, and U.S. intelligence agencies, but it could also serve as a platform for scientific research, which was a major argument for the establishment of a space station.

But Nixon's goals as president had very little to do with space. Barely five months after the historic *Apollo 11* moon landing, he asked his advisor John Ehrlichman in a budget meeting on December 26, 1969, whether they should "close Kennedy [Space Center]" in 1972.[53] Nixon was not even a lukewarm advocate of spaceflight unless it could help him politically. NASA leadership understood that and were forced to play a compromising political game to get at least one program supported by the president.

When NASA administrator Dr. James Fletcher boarded his flight to Los Angeles on January 3, 1972, he carried with him a copy of a statement he was planning to deliver following President Nixon's announcement of his support for the Space Shuttle program. (Jim Webb had left NASA in October 1968. Dr. Thomas O. Paine succeeded him, staying in the job until September 1970. Fletcher then succeeded Paine.) On that flight, Fletcher handwrote his changes to the statement so it could be retyped once he reached the Western White House.

This statement is historically significant for many reasons—some of them involving the troubled political and technological design history of what became the Space Shuttle. But the statement, and what was attached to it, is also highly important as a landmark document in the history of NASA's treatment of women and their possible inclusion into its elite corps of astronauts. Stapled to the statement was a brief Space Shuttle "fact sheet," a primer composed so that the administrator would be ready to deliver succinct answers to basic questions about the Shuttle's design, performance capabilities, and crew that Nixon, his people, or the press might ask. On this fact sheet was an answer to one question that contained a highly noteworthy admission: "No special flight training would be required for passengers, making it possible to send scientists, doctors, artists, photographers—both men and women—into space."[54]

For the first time ever, a NASA document meant for presentation by a top space program official stated outright that NASA planned to put women in space. But the final document was not entirely progressive. In the answer to another question on the fact sheet—the question being "What is the complement of the space shuttle crew?" meaning, who would fly the Shuttle?—Fletcher scratched out one word. The original answer read, "The orbiter will be piloted by *women*" (emphasis mine). Reading that sentence, Fletcher marked through the word "women" and replaced it with "a crew of two."[55]

Figuring out what Fletcher had in his head when he changed the document is highly problematic, as he seems never to have commented or reflected back on it. But clearly, whatever Fletcher was thinking when he drew a dark line through the word "women," his rationale must have related to the political risk of even suggesting to President Nixon the idea of putting a woman at the controls of NASA's new space vehicle. What is also clear is that someone at NASA headquarters strongly supported the idea of women pilot-astronauts, or else the phrase would not have made it into the penultimate draft of Fletcher's fact sheet. The historical record does not identify who composed these answers for Fletcher, but the statement still pushed political boundaries, as it was still more than two months before the EEO Amendment was passed. Unquestionably, there existed at least one person in an elevated position inside NASA (perhaps NASA associate administrator George Low) who believed in fuller participation by women in the space program—and as pilot-astronauts, not just scientist-astronauts.

To the front of the document he had revised, presumably Fletcher (although it may have been Low, who accompanied Fletcher to California for Nixon's announcement) wrote a note to his assistant that read, "Here are the marked up versions used to make the final ones at the Western W[hite] H[ouse]. Any point in keeping these? See second line on p. 12!! [the crossed-out word]."[56] Unquestionably, the NASA administrator felt that suggesting that women would pilot the Shuttle was not a notion worth the risk of sharing at that time with President Nixon. As a Mormon from the highly conservative and Republican state of Utah, Fletcher was likely personally uncomfortable with the idea of women commanding the Shuttle. Yet, the very fact that he asked whether the marked-up copy should be preserved intimates that he understood the significance of what he had deleted from the fact sheet.[57] Despite Fletcher's change, the document provides clear evidence that some of the members of NASA's leadership were developing a

vision of women and the space program that pushed the limits of what the country—certainly the president—expected for women in the workplace.

There is another, although highly remote, possibility that the word Fletcher crossed out was only a typographical error. Maybe the word "women" should have read "*two men*," but the typist left out the "t" and closed up the space between the "o" and the "m," thereby negating some of the historical significance of this particular document. The most sensible conclusion was that its author meant it to be stated just so, with the word "women," and that Fletcher, already anxious and uncertain about Nixon's support for the Shuttle without adding a social agenda, deleted the word. It seems highly unlikely that Fletcher would have saved the document because of a typographical error and more likely that he replaced "women" because of his unwillingness to make that announcement.

As NASA moved forward in the early 1970s to establish a new astronaut selection program for the Shuttle, the American public again debated the idea of a sexually integrated astronaut corps. The *San Jose Mercury* ran an article in July 1972 based on an interview conducted by the paper with former astronaut Frank Borman, commander of the famous *Apollo 8* flight of December 1968 that first circumnavigated the Moon. One of the questions for Borman was, in light of the fact that "women in space is moving closer to reality" and "now that America's space program is climbing out of the experimental and test stages and nearer to more or less routine space transportation modes," how long will it be before there are women astronauts? Borman answered, "I can see a role for women in space before long, if they can qualify. However, using women astronauts during the experimental stages of the space program, when we were testing all sorts of systems and the risks were high, would have been silly. They could have caused more problems than they would have been worth."[58] An "old school" fighter pilot, test pilot, and astronaut, Borman, by the time he made this statement in 1972, had retired from NASA and the air force and had become a special advisor to Eastern Air Lines (in 1975, he became Eastern's CEO). Replacing him was a younger generation of NASA managers with somewhat different social and cultural attitudes and a greater commitment to making the concept of women in space genuinely work. It was these men in control of NASA in the 1970s and 1980s who pushed forward with plans to make women astronauts possible.

In the fall of 1973, the staff at NASA's Ames Research Center in California

conducted the first in a series of physiological tests on female volunteers as a way to help construct the physical selection criteria for the first class of women astronauts. Dr. Charles Berry, the director of life sciences at NASA headquarters and former chief physician of the astronaut corps, headed the overall project. Dr. David Winter undertook the daily leadership of the tests on twelve nurse volunteers aged 23 to 35 to find out how weightlessness and reentry forces might affect the female body.

From flight data, NASA doctors knew that men suffered measurable cardiovascular deconditioning as a consequence of their time spent in microgravity. Dr. Winter and his primary investigator, Dr. Harold Sandler, wrote in their final report on this first in a series of bed-rest studies, "Women will play an increasing role in future space programs. They will be included as passengers in the upcoming Space Shuttle Program and will very likely participate in the Space Station Program envisioned for the distant future. The prospect of sending women into space, however, has raised a number of questions concerning the physiological capability of the female to withstand the deconditioning that has been observed consistently in both U.S. and Russian space crews after exposure to weightlessness."[59]

The tests lasted thirty-seven days, including a fourteen-day control period, seventeen days of absolute bed rest, then six days of recovery.[60] During the control period, all twelve women were put through a series of tolerance runs on a centrifuge, with analysis of lower body negative pressure and the effects of exercise. Then eight test subjects entered the bed-rest cycle while four control subjects remained ambulatory. During the period of bed rest, the researchers required the eight women to avoid any excessive movement, furnished them with one pillow, and allowed them to raise themselves on only one elbow to eat their meals. During the final six days, all twelve of the volunteers repeated the tolerance runs from the control period. If women were going to fly—and by late 1973 NASA was dedicated to that agenda—then doctors needed to know how the female body might react differently. Given that doctors suspected the loss of total body fluid as a major reason behind the physical deconditioning, as well as the fact that through menstruation women on average lost a greater percentage of their body fluid than men, such studies were viewed as an important step toward getting women into space.[61]

One of the central problems that NASA faced in "making space" for women had always lay in the attitude of the American public. In the 1960s

NASA had been the target of criticism by some for not having selected any women for spaceflight, while many more people would have condemned NASA if women astronauts had been selected. One might imagine that a limited science-based research program such as the bed-rest studies led by Dr. Winter would have created no major controversy and that those who had been advocating for women in space would have responded, "It's about time!" To the contrary, Dr. Winter found himself under attack. Argumentative letters came to him in the mail decrying the use of public money for such a study, pronouncing, "Women have no business in space." Some of the complaints came from women who lamented that "there are no mothers among the test group and that the results of the study on the nurses should not be compared with a similar study last summer on a group of younger male athletes."[62] Winter responded thoughtfully and with vigor, "This isn't a contest. Everyone seems to forget that this is the first of a series of studies. I don't see any reason to suppose that women are not capable of space missions, as the Russians have shown. And I personally believe women have as much right in space as men."[63] So, even as NASA's scientists and doctors endeavored to learn the basics of what was needed to qualify women for spaceflight, the culture clash arguments over mixing the sexes in what had been a totally male-dominated space lingered on.[64]

Dr. Winter continued his tests throughout the 1970s, testing both men and women up to the age of 65.[65] About the tests he said in May 1974, "By the end of this decade, we hope to have a Space Shuttle in service which will operate like a bus. There are going to be other people aboard the rockets apart from the pilots, and scientists come in all sizes, shapes and sexes. So we want to find out how far and wide we can open up the field."[66]

The seventies was a far different decade for NASA than the sixties. Funding had been drying up as the public questioned more and more pointedly whether money spent on human spaceflight made sense in comparison to other human needs.[67] A March 1971 media poll, which compiled responses from hometown newspapers in assorted congressional districts around the country, asked what people believed were the most vital issues facing America in order of importance. The responses listed, in order of highest priority, the Vietnam War, environmental protection, education and welfare, urban improvement, declining morality, minority problems, and national defense. Space exploration sat very low on the list. When asked about how the U.S.S.R. prioritized its ambition, the American people who were polled felt that the

Soviets put only one priority higher than their space program, and that was national defense.[68] NASA found itself facing a public affairs dilemma.

With the glory days of the Apollo program burning out like a supernova and dreams of space travel quickly receding into the fringes of the American psyche, NASA tried to mold its agenda for spaceflight into something that would continue to hold the public's attention, if not excite it. Memorandum after memorandum circulated inside and out of NASA's Office of Public Affairs, desperate to find any way for the agency to rekindle public interest in the space program.[69] To build and operate a worthwhile Space Shuttle, NASA could not afford a steady drop in its budget. But to win back public and congressional support, NASA required a bold new emphasis.

NASA leaders had struggled to redefine the nation's space agenda. In a letter to Edgar M. Cortright, the director of NASA's Langley Research Center in Virginia, George Low wrote back in June 1971, "It has been suggested that NASA's role should be broadened—that NASA should undertake the solution of technological problems that face the Nation, in addition to its responsibilities in aeronautics and space."[70] Low asked his old fraternity brother from Rensselaer Polytechnic Institute to lead an in-house NASA study to determine what kinds of "non-aerospace technological problems" could realistically be addressed by the space agency for which practical solutions could be found and applied.[71] Cortright accepted and went to work to find more specific Earth-related applications for NASA R&D.

Six months later, on January 10, 1972 (just five days after President Nixon announced his support for Space Shuttle development), Low sent out a similar appeal, this time to Brian O'Brien, chairman of NASA's Advisory Council. In reply, O'Brien offered, "To make the program of the 1970s most effective and fruitful, it would be helpful to have some insight into what the space program should be and is likely to be in the 1980s."[72] As political scientist Mark Byrnes demonstrated in his 1994 book *Politics and Space: Image Making by NASA*, space advocates of the late 1950s and 1960s had benefitted from a Kennedy-inspired political culture rich in "new frontier" symbolism and Camelot-style romanticism, which enabled NASA to foster a heroic mythology, really without too much effort on its own.[73] The more cynical and pragmatic political culture of the 1970s posed a far greater public relations challenge to NASA—one in which direct image creation by the agency was more important than previously, and one in which NASA, as Administrator Fletcher expressed it, "looked ahead to several decades of

a highly rational use of space" and "a period of space exploration for practical purposes."[74]

Low, as NASA's deputy administrator from December 1969 to his retirement in 1976, found himself entrenched in figuring out public affairs issues. Concerned with the effectiveness of NASA's publicity, Low admitted that improvements had to be made: "Even though I am certainly not content with the NASA image, I do feel that our public affairs program is extensive in scope, and by no means static."[75] In his earnest attempts to improve the agency's public image, Low exchanged letters and shared conversations with astronomer Carl Sagan, later renowned for his PBS television series *Cosmos*. Dr. Sagan shared his thoughts with Low about how NASA could improve its public image.[76] Low also looked to acclaimed marine biologist Jacques Cousteau for help. Not only did Cousteau possess his own personal ambitions to fly in space, but his skill and success with filming and producing documentaries of his underwater oceanic exploration offered Low a model for its own public presentations.[77] Candidly, Cousteau condemned the quality of NASA's television spots, declaring that "they are worse than commercials and people are more likely to leave their TV sets when these come on than they are even for commercials." As for the NASA seal that appeared at the beginning of all its documentary "shorts" and the strong parade-like music that accompanied most of them, Cousteau told Low that they smelled "of the worst kind of publicity or advertisement" and were "counterproductive."[78] NASA's space efforts in the 1960s may have been able to sell themselves, but, in Cousteau's estimation, the agency's attempts to reinvigorate the public's interest in spaceflight, up to this point, were doing more harm than good.

A NASA assistant executive officer by the name of Harvey Herring took Cousteau's written comments to heart. In a memo back to George Low, Herring lamented, "NASA presentations too often focus on the agency and its people as primary subjects. An atmosphere of arrogance is clearly discernible, especially where manned space flight is concerned. The people whom we choose to front for the agency are seldom content to be narrators in the background. Instead they tend immaturely to draw attention to themselves, to their roles, and to the superior capabilities they and the agency have for performing them. The public has an easy escape from such nonsense. They switch channels and watch Cousteau."[79] Low himself concluded that the public would relate better to NASA if the agency's efforts at outreach emphasized "the down to earth benefits" like those based on data being collected

from the Earth Resource Technology Satellite (ERTS), which monitored the Earth's surface and environmental situation.[80] As mentioned, Low had asked his friend Ed Cortright, Langley's center director, to identify various scientific and technological challenges that NASA could address and apply to solving other national problems. By emphasizing the contributions that NASA could make to society through R&D—particularly those contributions that could be based on Space Shuttle (as well as Spacelab) operations—NASA public relations could forge an entirely new message for the marketing of spaceflight. Greater involvement in space missions by scientist-astronauts and the inclusion of the new "mission specialists" specifically for the Shuttle would be a linchpin in NASA's new approach to public affairs.

In September 1975, the Ad Hoc Subcommittee on the Scientist-Astronaut in NASA's Advisory Council submitted a report to George Low. For the Moon missions, NASA had selected two classes of scientist-astronauts so as to achieve the best possible collection of geological samples from the few lunar landings that Americans would make. When Apollo ended, the ad hoc subcommittee got the task of evaluating the efficacy of including those scientists (like *Apollo 17*'s Dr. Harrison Schmitt) in the astronaut corps for the new Shuttle program.

The panel report asserted that by "bridging the sometimes wide gap between scientific and flight operations points of view," the scientist-astronaut "can contribute to a productive Space Shuttle science program."[81] The record of achievement compiled by Apollo scientist-astronauts like Harrison Schmitt (who was the only one of them actually to fly a Moon mission—three others had flown on *Skylab* before the committee completed its report) also justified NASA's plans to select "mission specialists" specifically for the contributions they could make as researchers.

Following up on this conclusion, and in order to maintain the highest possible quality of scientific and engineering knowledge in the astronaut corps, NASA went on to establish the "Life Sciences" and the "Space and Applications" Astronaut Offices at Johnson Space Center, mainly as a way to keep the scientist-astronauts engaged actively with their core disciplines.[82] This new scientific emphasis within the human spaceflight program significantly bolstered NASA's new agenda and public profile as it moved deeper into Shuttle development.

There was another element of NASA's redefinition of its image in the mid-1970s that focused explicitly on the pursuit of equality for women. Not

long after the twelve nurse volunteers participated in Dr. Winter's bed-rest study at NASA Ames, four women who were scientists or engineers took part in a Spacelab simulation at Marshall Space Flight Center (MSFC) in Huntsville, Alabama. For five days in December 1974, Doris Chandler, Carolyn Griner, Ann Whitaker, and Mary Helen Johnston spent their eight-hour workday in MSFC's General Purpose Laboratory (GPL), where they participated in a series of experiments similar to those anticipated to fly aboard Spacelab, the European-built science module for the Space Shuttle.[83] Unlike the bed-rest experiments in California, what the women did during the GPL simulation had nothing to do with proving whether women could work as mission specialists. The goal was rather to establish a working understanding of the kinds of experiments that any astronaut could be expected to perform in space: "what can and cannot be done in weightlessness and what handholds, foot restraints and other devices are necessary."[84] Media coverage of the test program featured more than the mere presence of women employees at NASA Marshall; it showed women working as scientists and engineers and as vital contributors to the human space program. Although differences in size and physical strength among the astronauts, demonstrated in these tests, would eventually require more analysis into how such experiments should be designed, the work of these four women at Marshall not only set a precedent for science in human spaceflight but also improved understanding that the sex of a scientist or engineer fundamentally made no difference in how well a physical or mental job in space could be done.

Not every NASA office excelled in its efforts to improve equal employment opportunities within the agency. Plenty of memos and other documents from throughout the 1970s demonstrate inertia on equal rights and how important it was for NASA as an agency to pursue centralized efforts for advancing qualified women and ethnic minorities into upper-level positions.[85] George Low sent out progress reports to each of the NASA centers evaluating their EEO performances, indicating either his pleasure or disappointment.[86] Although concern for the agency's public image fueled some of Low's interest in equal rights, personally Low seems to have been highly committed to giving women equal opportunity—even as astronauts.

NASA's decision to move toward sexually integrating its astronaut corps stemmed largely from the agency's changing agenda, one that focused throughout the 1970s more on scientific developments and a long-term and incremental movement of humankind out into space than a "crash" program

designed to beat the Soviets or anyone else to any particular goal. That momentum for sexual integration also derived, naturally, from slowly changing attitudes about what constituted discrimination within American society as a whole.

Although the final design of what became the Space Shuttle did not create much more room for astronauts on board—or thus more privacy for crew members (as early speculation by the media predicted), NASA's vision for its new space vehicle and that vehicle's multifaceted mission nicely paralleled the growing national commitment to equal opportunities for women in education and the workplace. In doing so, a "hatch" opened through which America's first female astronauts could finally move into a spacecraft and head for orbit.

In the next chapters we will see, through detailed analysis of the actual training and spaceflights of the first six U.S. women astronauts, just how difficult sexual integration of the astronaut corps really was.

CHAPTER 5

"The Strange Ones"

On January 16, 1978, NASA introduced its first new class of astronauts in nine years. Designated as Group VIII, the class of 1978 represented not only the largest class of astronauts in agency history but also the first to have the appearance of "a NASA affirmative-action poster."[1] For the first time, the class of fifteen pilot-astronaut candidates and twenty mission-specialist candidates included three African American men, one Japanese American man, and six women, all Caucasian.[2] Selecting such a heterogeneous class of potential American astronauts carried with it a host of social and logistical issues that NASA would have to address if the women were ever to fly in space. People at NASA's Johnson Space Center hoped they were ready for the challenge, as they had been fighting to achieve effective sexual integration of its astronaut corps from the early planning for the selection of this class.

Even the tone of that first press conference in January 1978 signaled something significant. Presiding over the event, NASA's director of public affairs Robert Newman began by introducing two key members of the selection panel: deputy administrator Alan Lovelace and Johnson Space Center director Christopher Kraft.[3] NASA administrator Robert A. Frosch then delivered a short statement explaining that the selection committee had begun notifying the new class of thirty-five "Astronaut Candidates" beginning at seven o'clock that morning. In two weeks' time, Frosch indicated, the "ASCANs" would arrive in Houston for orientation and then officially report for training in July. Frosch then turned the floor over to the reporters attending in Washington, D.C., the Houston reporters connected via telephone, and the NASA employees listening "live" from their respective field centers.

Although this was the first class of astronauts selected for the new Shuttle program, simply that the new class included women and racial minority men for the first time was what made it most newsworthy. The media was primed to ask questions about the women and racial minority men whom NASA had

selected and little else. Journalist Mark Walton from the Independent Television Service (ITVS) asked a question that clearly suggested that the general public still saw the women selected as less prepared and perhaps less capable to serve as astronauts, even though women had been working in technical fields in growing numbers during the previous two decades. Walton queried, "My questions are to [NASA's] experience with women in the selection process and what provisions are there for them in specific training, just a little bit about what has been interesting about them."[4] Veteran NASA flight director Chris Kraft responded, "I think the most rewarding thing was that we found that there are a large number of very highly qualified women in the United States who can make the qualifications that we set out for astronauts. We don't propose that they [the women] get any kind of different training, in general [than] all the candidates, with the exception that we hope to maintain the proficiency they have in the fields in which they are trained, so that that allows us the skilled mix that we are looking for in the training of mission specialists."[5]

When the "thirty-five new guys," as the classmates dubbed themselves, arrived for their own press conference two weeks later, all eyes focused on the half-dozen women and the trio of African-American men.[6] Astronaut candidate Kathy Sullivan recalled, the class was "twenty-six average white guys and nine strange people."[7] What began that day for the first American female astronauts was a teamwork approach to problem solving not unlike that used by all earlier classes of astronauts. In their case, the women were establishing precedents, not specifically for their class or the astronaut corps as a whole, but for their sex.[8] The process of sexually integrating the astronaut corps, however, had started several years before these six pioneering women had heard about the call for new astronauts.

On September 11–12, 1972, NASA center directors met with Administrator Fletcher and Deputy Administrator Low at the Peaks of Otter Lodge in Bedford, Virginia. In a memorandum for the record following the gathering, Low identified the meeting's top two priorities. The first was to make sure that the agency as a whole, but particularly at the center level, took "positive, deliberate steps to develop sound, affirmative action plans and to see to it that these plans are carried out." Second, Low noted that Houston's Chris Kraft needed to develop a plan to assure not only that NASA had enough astronauts trained and ready to fulfill the demands of the Shuttle program, but also that whatever plan developed took "into account present equal

employment opportunity policies and practices."[9] Clearly, Fletcher and Low were both supporting the expectations of equality in hiring that Administrator Webb had set down in 1966—and that federal law now dictated.

The discussion at the Peaks of Otter Lodge paid more than lip service to the EEO law and the women's movement. After reviewing the plan for the "Astronaut Selection Program" in December 1975, Low wrote back to John F. Yardley, the associate administrator for space flight, "The plan does not indicate a method for insuring application by minorities and/or women in the new astronaut group and mission specialists group. I am sure that you are aware of the importance to NASA that every opportunity be presented to these potential candidates to encourage application and, if qualified, selection."[10] In no uncertain terms, NASA's upper management wanted women and minorities in the astronaut corps and was therefore insistent on solicitation of their applications. But a good number of the applications had to be successful. If women and minorities applied but none were selected, then the agency would be forced to backpedal and explain to the FLATs, journalists, and activists why no women were invited to join the astronaut corps, just as none had been selected in the astronaut classes of 1963, 1965, 1966, and 1967.

NASA released its call for the new class of astronauts on July 8, 1976, four days after the country's bicentennial celebration. In their public statement, agency officials declared upfront, "NASA is committed to an affirmative action program with a goal of having qualified minorities and women among the newly selected astronaut candidates. Therefore, minority and women candidates are encouraged to apply."[11] Along with the announcement, NASA sent out some of its own people to recruit. Never having undertaken an initiative quite like this before, a more aggressive and public approach to recruiting astronaut candidates was about to begin.

One might not think that NASA would face a hard time finding astronaut candidates, but that turned out to be the case. To convince Congress and President Nixon to support funding for the Shuttle fleet, NASA had created an image of spaceflight becoming "routine," an exaggerated argument for keeping costs down.[12] Reinforcing this idea were comments like those made by *Apollo 8* commander Frank Borman that women would join the astronaut corps when spaceflight was no longer experimental and becoming more routine—which seemed to be happening with the Space Shuttle.[13] But could "routine" spaceflight captivate the interest of a new generation of astronauts?

Beginning with the Mercury Seven, the public regarded astronauts as American heroes. If their job became "routine," fewer people might be interested in participating.

With its previous astronaut classes, NASA had little need to recruit new astronauts. The applicant pool was inherently small and usually came directly from the military, where much of the weeding-out process was handled before applications reached NASA's selection committee. The scientist-astronaut classes from the mid-1960s on all came through a screening process handled by the National Academy of Sciences. While those who were pilot-astronaut candidates in the class of 1978 still hailed largely from the service branches, NASA now aimed to handle the entire selection process for the new mission specialists on its own. At the very least, the agency required an active recruiting effort to ensure the chances of obtaining a group of qualified applicants large enough to give the selection committee some good choices. NASA also focused on recruiting women and racial minorities to the astronaut corps, guaranteeing that the selection committee would have a strong body of qualified women and minorities from which to select. NASA wanted—and arguably needed, if only from a public relations standpoint—women and racial minorities to matriculate into Group VIII.

One person who played a significant role in the selection process of Group VIII was Dr. Carolyn Huntoon. Already recognized for her leadership role at NASA, after she turned down the opportunity of being an astronaut—JSC director Chris Kraft had asked her if she wanted to apply for Group VIII—Huntoon became the first woman ever to serve on an astronaut selection committee.[14] She was also the only woman on the selection board for the class of 1978.

Huntoon's presence on the selection committee was hardly mere tokenism, as her many contributions to the recruitment, selection, and training of the first women astronauts attest. Huntoon was one of the people NASA sent around the country to encourage young men and women to send in applications. She traveled to universities to meet with students in science and engineering departments, making sure to deliver special addresses to potential female applicants, such as members of the Society of Women Engineers. Years later, Huntoon clearly remembered being informed that there were still very few women in the pipeline who met the eligibility requirements as pilots or mission specialists.[15] Whenever she gave her recruitment talks,

Huntoon knew that her strong encouragement to those women who did possess the necessary credentials was crucial if high-quality women were to be selected as NASA's first female astronauts.

The task proved troublesome. Huntoon recalled, "A lot of [potential applicants] didn't believe NASA was going to select women and minorities. They saw it in the paperwork. But their questions led me to believe they were dubious of whether NASA was sincere or not."[16] Despite the changing federal laws and the efforts of the feminist movement, Americans remained skeptical of NASA's policy statement about the employment of women and minorities as astronauts. Both to pacify doubters and to energize recruiting, NASA pulled out a big gun, teaming up in 1977 with Nichelle Nichols, the 44-year-old actress who played Lieutenant Uhura on the popular *Star Trek* television series, and the company Nichols cofounded, Women in Motion, Inc., with the aim of promoting technological careers particularly for females and racial minorities.[17] Nichols toured the country giving talks and encouraging people to apply for astronaut selection. While the number of applications that NASA received as a direct result of Nichols's efforts is unclear, after six months of touring and lecturing applications increased from 1,500 to over 8,000. Nichols said, "I like to think some were encouraged by me."[18]

With over 8,000 applications in hand by the closing date (June 30, 1977), NASA's selection committee narrowed its pool down to 187 men and 21 women, all of whom were to be brought to Houston for medical exams and interviews.[19] The agency had spread its recruiting efforts to universities nationwide in hopes that the selection board would encourage a good number of highly qualified women and ethnic minorities to join the pool. Carolyn Huntoon does not remember the committee members ever being told they had to meet an affirmative action quota of any kind, but a document from NASA's associate administrator to his assistant administrators dated February 15, 1977, did state, "Minority and female candidates *will* be among those selected" (emphasis mine).[20] Politically NASA knew it was important to select astronaut candidates from different constituencies. Interviewing women and minorities of extraordinary caliber was crucial to NASA's integration plan. According to Huntoon, "We always said once they applied, they had to go through the same processes and we would only select them if we thought they would be outstanding, because it was going to be tough—hard on the men *and* women."[21] Both the training and the job would be

time-consuming, physically challenging, stressful, intellectually rigorous, and would not come with any guarantees of a flight in space. Every astronaut, male or female, had to deal with those realities.

The constitution of Group VIII raised new kinds of questions for the selection board. The design of the Shuttle, given the size of its crews and the limited cabin space they shared, gave rise to its own type of compatibility issues. Beginning in the 1980s, Shuttle crews were to be made up by as many as seven astronauts who could be in orbit for up to thirty days.[22] Astronauts would spend considerable time together both in space and on the ground. Unlike the Apollo crews of the 1960s and early 1970s, who learned who their crewmates would be no more than six months before a flight, Shuttle crews actively began training together a full year before the scheduled launch.[23] Rhea Seddon, who eventually flew on three flights and married pilot-astronaut Robert "Hoot" Gibson (who flew five times), said of her experiences of relating to crew members as both astronaut and spouse, "I got to be a part of eight crews instead of three crews. A lot of social activity revolved around the crew that you were assigned to. People socialize together, did a lot of things together, and with only three flights I would have only been involved with that in three crews. But since my husband flew five times, I really got involved in eight crews. There is a lot of camaraderie being a part of a crew."[24] In contrast, the crew for the historic *Apollo 11* Moon landing in 1969—Neil Armstrong, Michael Collins, and Buzz Aldrin—related to each other, at best, as "amiable strangers."[25] If a Shuttle crew could not relate to each other well, it could adversely influence the success of the mission. Kathy Sullivan noted, "You don't necessarily want the guy who's the hyper-brilliant lab bench or computer guy if he does not even have the social connective tissue in mind."[26] In other words, Shuttle crews worked best together when their members had the skills to get along together amicably.

It was important, therefore, for the selection board to figure out how well each of the applicants who made the trip to Houston dealt with others. One concern over the selection of the Group VIII astronaut candidates, according to Associate Administrator John Naugle in a memo to NASA's section heads, was how to measure such personal characteristics as "adaptability, self-discipline, confidence, poise, imagination, empathy, enthusiasm, and creativity," which together indicated an astronaut's ability to cope with his or her crewmates.[27] Getting at those traits of personality and character required

asking the applicants many penetrating personal questions and pursuing much deeper insights from those listed as references.

The psychological exams taken by the 208 applicants invited to Houston did little to flesh out the personality characteristics of a "good astronaut." Huntoon explained, "We have some psychiatric and psychological testing to screen out people who have mental disorders or pathology or borderline pathology. But as far as good-personality types of screening, there isn't such a thing. There are no psychological tests for 'screening in' people; we have lots of 'screen-out.'"[28] In her view, no psychiatrist or psychologist has ever designed a personality test that can determine "who is comfortable with themselves, is smart, knows it, but yet is willing to listen to others and be part of the team and be led or lead. Those are the kinds of characteristics you look for, and those are very difficult to talk about, to score, or to tell."[29] Kathy Sullivan agreed, "It's in the context and almost fragrance of the interview. It's the other things that come across by how you carry yourself. How do you connect yourself to the other people? How do you handle ambiguity? How do you handle other groups of people?"[30] To uncover that kind of information, the selection committee had to ask many rich series of questions both inside and outside of formal interviews.

The potential ASCANs spent a week in Houston undergoing interviews and medical exams before the selection committee made its final recommendations to Center Director Chris Kraft. Typically, the 208 applicants arrived in groups of about twenty and were encouraged to spend their time together while in Houston. Kathy Sullivan remembered her week at Johnson Space Center: "We were encouraged to meet other people. It's your chance to get a one-week look at this, too."[31] Of course, bringing the applicants to Houston in groups made the process more enjoyable for the interviewees and streamlined the process for the selection committee. But even more important than revealing the personalities of the applicants, having the applicants interact with one another over the course of the week gave the selection committee a chance to ask at least a dozen other people what they thought of the other candidates. Of uncovering information about an applicant's personality, Huntoon said, "You get the feelings from talking to them, talking to people that know them, talking to their references, and talking to people that know them that they did not give as references. That is just as important because filling out forms does not do it."[32]

The selection committee spent the fall of 1977 conducting interviews and gathering information. The committee's challenge was to cut the total number of interviewees down to fifteen pilots and fifteen mission specialists. Still not entirely sure what NASA would ultimately need for the Shuttle during the years of its life span, whatever that would turn out to be, the committee built in some flexibility by selecting more astronaut candidates than originally expected, particularly with respect to mission specialists. In December 1977, the committee finally submitted to Kraft the names of fifteen pilots and twenty mission specialists, which became "the thirty-five new guys."

The selection of Group VIII was NASA's first class of astronauts selected since 1967. Interest in the new Shuttle program alone would have made this newsworthy, but it was the class's ethnic and gender diversity that provoked the most attention.[33] Kathy Sullivan remembered the first media appearance: "That was a huge wall-to-wall interview day. I think we were introduced at ten in the morning and then there was immediate availability [to the press] from eleven on. Of course, 'the twenty-six average white guys' were done at 11:15. Then it was our turn, 'the nine strange people.' The twenty-six standard White guys had the day off from about 10:30 on and the nine strange people were there till I don't even remember how late . . . forever."[34] From a public affairs standpoint, the presence of women and minorities in the new class was a truly positive achievement for NASA—something the whole class knew and accepted. But publicity only took the ASCANs so far. What they needed to take them the rest of the way was many months of extensive and solid training.

Since 1961 America's astronauts had made their professional home at the Astronaut Office at Johnson Space Center (originally known as the Manned Spacecraft Center). The staff at JSC was primarily concerned with keeping its astronaut corps trained and ready to fly. NASA's public affairs (PA) offices in Houston and Washington sometimes proposed media events and astronaut appearances that conflicted with the astronaut office's primary mission. If the 1978 class of astronauts was to succeed as a whole, the objectives of the astronaut office and NASA's public affairs offices needed to gel, giving the ASCANs sufficient time to work and train without too much distraction from public appearances and interviews. As soon as Chris Kraft had announced the names of the incoming class in January 1978, PA officers had gone to work setting up media time with the new ASCANs, particularly involving their hometown TV and radio stations and newspapers. But training requirements

brought that to a rather quick halt. As soon as the candidates arrived in Houston in July to begin training, Kraft made sure that public affairs would enforce a media and press moratorium for the Group VIII astronaut candidates that would last for at least six months. This reprieve allowed "the thirty-five new guys" to establish their footing.[35]

Still, throughout the spring of 1978, comments and photographs involving the six female ASCANS frequently appeared in papers around the country, from the *Houston Chronicle* to *Florida Today* to the *Christian Science Monitor*. The women answered questions about how their families were handling the news, what in their backgrounds had gotten them interested in becoming astronauts, and whether they were concerned about the risks they would be taking. In Shannon Lucid's case, questions also concerned how her children felt about their mother being an astronaut, and in Anna Fisher's case, how hard it must be on her husband, Bill, that she had been selected as part of Group VIII while he had not.[36] All of the women—as well as Bill Fisher—handled the attention with considerable patience. Compared to other astronaut classes, the media barrage directed toward the six women likely surpassed all but the coverage given to the original Mercury Seven astronauts and the historic *Apollo 11* crew.

Even after their training started in Houston and despite the attempts by the astronaut office to make the ASCANs off-limits to the press, the attention did not cool. One of the early field trips made by sixteen of the ASCANs was to Homestead Air Force Base's Water Survival School in Florida.[37] Despite the moratorium, the media besieged the women, snapping photographs and shouting questions.[38] The women's frustrations with all the attention started to come through. *Newsweek* reported that when a television reporter shouted, "Hey, Miss" to gain Rhea Seddon's attention, she shouted back, "It's Doctor!"[39] When a photographer asked Sally Ride for "a happy face," *Time* magazine wrote that she "screamed, 'No!' "[40] At the same time, the media also scrutinized the male ASCANs, many of whom were being asked for the first time to work with women as equals. *Time* reported, "Not all the astronautical hopefuls felt such aversion to media coverage. Pouted one of 42 [sic] men in the program: 'We're mere commoners.' "[41] And the job of training to become astronauts had only just begun.

When "the thirty-five new guys" showed up on the JSC campus as astronaut candidates, they faced training that was slated to last two years. Everyone in Group VIII was very bright, but not everyone necessarily knew a lot

about NASA or even about spaceflight. Their training served to introduce them to what it meant to be an astronaut but additionally prepared them for their assignments to flights and ground support positions.

At their JSC orientation, the candidates received briefings on what the training program entailed and on plans for the Space Shuttle program. But the astronaut office also made sure that someone spoke to the candidates about the history of spaceflight, the folklore that could affect an astronaut's job, their code of conduct, and the expectations of them with respect to public appearances.[42] Human spaceflight had been NASA's most public and marketable feature but also Congress's first topic of debate when arguments flared over how NASA allotted its budget. Since 1959 when the Mercury Seven were selected, the astronauts had been the public face of NASA, and the "affirmative action poster" look of the 1978 class, along with the development of the new flight vehicle, promised to bring renewed interest in the space program. As astronauts, these pilots, scientists, physicians, and engineers—who otherwise would have gone through life without much fanfare—would become celebrities of a sort. Carolyn Huntoon compared the fame of astronauts to that of Nobel Prize winners:

> When someone wins the Nobel Prize, they can win it for a very esoteric enzyme, and then people ask them, "Well, what do you think of nuclear war?" The same thing happened to astronauts. Today I just got my Ph.D. or my M.D. and I was doing an internship or I was doing research in the lab somewhere and tomorrow I'm an astronaut and I'm supposed to know who was the first astronaut in space or who landed on the Moon or what the Shuttle's going to do and why we can't go to Mars. All in one sentence, someone will ask something like that.[43]

Similar to the earliest classes of astronauts, the class of 1978, particularly the women, became overnight celebrities. The astronaut office did what it could to protect them from public distractions, but meeting with the media, making appearances, and giving lectures were invaluable to public and political support for the agency. NASA wanted to ensure that the astronaut candidates were aware of their rights and responsibilities as individuals and as government employees and familiar with all the different resources available to help them do well in their roles as public figures. But NASA also definitely wanted to keep its astronauts front and center.

The bulk of the ASCANs' training provided candidates with "the necessary

background and indoctrination they must acquire before beginning preparations for their Shuttle flight assignments."[44] Understandably, the training was time-consuming and demanding. Like airline pilots, who qualify on the specific aircraft they will be flying, the Group VIII ASCANs were training to fly on board the Space Shuttle. That entailed learning all the Shuttle's systems, their function, how the systems worked, and how to work with them. The training approach was threefold: studying workbooks and manuals for each Shuttle system, attending lectures on the systems, and practicing on simulators and trainers. ASCANs spent their days split among classroom lectures, workbook study, T-38 flying (particularly for the pilot candidates), and (later on) simulator work.[45] But the work did not end on Friday. Weekends meant time to study.

While pilot and mission specialist candidates ultimately had different jobs during a mission, the class still trained largely as a whole. Although the selection committee picked the candidates for their individual skills and educational backgrounds, NASA benefitted more from an astronaut corps as a whole with broad experiences and capabilities. But the astronaut office also needed each astronaut to be competent in general fundamental areas. When Flight Crew Operations managers assigned astronauts to missions, they tried to select those who best complemented the flights' scientific or military aims. But if the astronauts all shared an equal familiarity with life sciences and astronomy, then NASA could expand its mission profiles to include basic experimentation and studies even if the crew did not include a specialist in that field. To ensure that everyone was knowledgeable in the appropriate sciences, the Group VIII candidates participated in coursework on space science, astronomy, bioscience, and earth sciences and planetology.[46]

Shuttle training specifically, which the ASCANs began only after they completed their coursework on fundamental concepts—such as life science, computers, flight dynamics, and orbital mechanics—covered all the basic theories and systems of the Shuttle. The ASCANs spent several months studying the Shuttle's design and layout, the Shuttle systems, the liquid and solid fuel propulsion systems, the payload capabilities, flight control systems, environmental controls and life support, communications, the Shuttle's EVA capability, navigational systems, and the Mission Control Center's role in flight operations.[47] The classroom lectures instructed the ASCANs on how the systems worked and introduced them to the crew interfaces and controls.

But it was the simulators and trainers at JSC that gave them the opportunity to practice and exhibit what they were learning before they moved to on-the-job assignments.

All the ASCANs went through the same basic program. Each had to successfully complete this level of training before their advanced work could begin. During that period of initial training, neither the astronaut office nor the women themselves attempted to separate the men from the women.[48] Essentially all the scheduled training activities were mixed-sex. The entire class attended classroom lectures together. In some cases the class was split up, but not by sex. Usually the class was divided into small groups because of the ASCANs' individual training backgrounds, whether they were pilot or mission specialist candidates, or because of facility capacity and the need for more focused instruction as in the cases of space suit familiarization, water immersion training, and T-38 training.[49]

Only some of the astronaut candidates of 1978 had piloting experience. A pilot's license was not a prerequisite for mission specialists, but NASA still required some flight training for all of them. Even though their jobs had nothing to do with actually flying the Shuttle, mission specialists had to be qualified T-38 backseat-rated operators. Since NASA's fleet of T-38s served as the astronauts' primary mode of transportation between Houston and the launch site at Kennedy Space Center in Florida, even mission specialists had to know what to do as a T-38 passenger. So the mission specialist candidates participated in ground school, training flights, and high-altitude training. The ASCANs' instructors tweaked the number of training flights for each candidate based on his or her needs and experience. Although a larger percentage of the male ASCANs came out of the military and thus had already gone through some of this training, everyone's schedule was adjusted so that each individual, regardless of sex, could meet the minimum requirements of the training program.[50]

Not all astronaut training took place in Houston. The candidates had to go through the military's version of water survival training, which took place at Homestead Air Force Base in Florida. In addition, the astronaut office took all the ASCANs on field trips to the other NASA centers and to Shuttle contractor facilities. All the trips required at least one night away from home. NASA made sure that the men and women were afforded privacy during these overnight trips. Of course, everybody wanted his or her privacy, but NASA was also aware that public suspicion about *any* impropriety could be

highly unfortunate. Such a concern only grew after the thirty-five new guys got their flight assignments.

NASA worked to fend off any possible concerns about sexual impropriety or temptation with the agency's own increased sense of awareness and attempts to be sensitive to those concerns. All the ASCANs typically stayed in hotels during the field trips. But the increasing number of female personnel throughout NASA was a factor that the agency had to face. In a November 1979 document from Deke Slayton, who was serving as the manager for the first orbital flight test of Space Shuttle *Columbia*, to M. E. Burke of the Dryden Flight Research Center in California, Slayton wrote that the staff traveling for the test would need accommodations because the site for the landing—Edwards AFB—was a considerable distance from any town with hotel space. But to accommodate everyone, Dryden needed to make some changes to adapt to the presence of women on the team. Slayton wrote, "Sleeping/showering accommodations should include separate areas for approximately 20 women and 150 men."[51] When asked about privacy during training, Rhea Seddon offered this perspective: "We're all adults," suggesting not only that the women did not need to be chaperoned, but also that the ASCANs tried to respect each other's personal feelings without direction from NASA.[52]

But NASA had always been an organization of engineers, most of whom were men.[53] For most of these men, their working relationships with women essentially had been limited to secretaries; having to change their working environment to include women as equals and colleagues was a very new and awkward situation. The incorporation of women into the astronaut corps not only changed the public appearance of NASA; it also meant that NASA centers had to undergo physical and architectural modifications, and that the male scientists and engineers working for NASA had to adjust to working with women.

Very early in the 1970s NASA started designing the Space Shuttles to accommodate crews with both men and women. But design changes to the infrastructure of Johnson Space Center that were needed to accommodate women in the astronaut corps came more slowly, and often only following eye-opening experiences when people realized that no one had planned for all of the women's needs. According to a 1981 Shuttle fact sheet, the Shuttle's design and operation meant that its astronauts would no longer have to be limited to the "intensely trained, physically perfect astronauts" that NASA had required for its previous programs.[54] But they still needed to stay in good

athletic shape. To provide for that, Johnson Space Center operated and maintained a gymnasium to which the astronauts and ASCANs had priority access.[55] The gym and its equipment were adequate for the incoming class, but it lacked locker rooms for the women. As the only woman on the Group VIII selection committee, Carolyn Huntoon, by her own admission, became the "mother hen."[56] Often she was the one to step in and make sure those needs or accommodations got addressed.

Usually the changes came piecemeal. With respect to the gym, Huntoon noted, "There was one restroom, one dressing room, one bathroom. So we needed another one for the women." Because NASA had failed to anticipate that need, renovations for the gym were not in the budget. Huntoon praised, "But got it. The point was once you pointed out [the deficiency,] you got it there."[57] NASA issued every astronaut and candidate exercise clothes—meaning shorts and t-shirts. While men needed athletic supporters, women needed sports bras, which were not part of the inventory when the first six women entered the astronaut corps. It often took one of the women to point out the omission.[58] Sometimes it was just little things, at some level, silly things, recalled Huntoon: "Hair dryers, for instance—there were no facilities where the women would go do their T-38 training." After a training flight, Huntoon explains, "[You] throw off your flight suit and hung it up, and took a shower, put on your regular clothes, and dry your hair, put on your make-up and leave. Except the women had no restrooms. They finally got a restroom. They had no shower. They finally got a shower. It was just because it wasn't in anybody's mind that [these facilities] needed to be separate."[59] It still took time, money, and effort to make sure that the women had what they needed to do their jobs when on the ground. That included adequate exercise apparel and facilities. It would be a much greater challenge once the women went into space.

Carolyn Huntoon recalled, "We had to get things ready for women at the center. Attitude was the biggest thing we had to work on."[60] When asked whose attitudes needed to change, she admitted, "Whose attitudes? Just about everybody."[61]

When the six women of Group VIII reported to NASA, it had been over twelve years since Administrator James Webb first mandated agency policy against sexual discrimination, and nearly six years since James Fletcher and George Low made it clear to JSC's Chris Kraft that the next selection commit-

tee needed to actively pursue applications from female candidates. But when the time came, Huntoon remembered that some people responded with "Oh, we're going to have women astronauts!?"[62] It begs the question how much "warning" and lead time people at a NASA center needed to prepare for women astronauts.

The changes that NASA veterans witnessed in the 1970s as a result of the introduction of women simply could not have been fully anticipated. Huntoon explained, "Some people were glad, and some people were not happy. But they had the good sense to keep their mouths shut about it."[63] Prior to the federal legislation of the 1960s and early 1970s, a gender hierarchy dictated American society and American workplaces. Right or wrong, fair or unfair, it defined the lifestyles of many Americans. Given that many JSC scientists, engineers, and even secretaries in 1978 came from an older generation with different ideas about gender than the new class of astronauts, one should hardly be surprised that some ill feelings arose despite NASA administration's attempts to send a clear message over several years that female astronauts would soon be a reality.

The generational ideas about women did create some issues that even Carolyn Huntoon, as the "mother hen," struggled to accept and overcome. When the six women joined NASA, they wanted and expected to be held to the same standards as their male counterparts. But from Huntoon's perspective, "That's the sort of thing that we had to get over, that we have got to treat them the same. We've got to expect the same out of them. They're going to train the same, we're going to expect them to behave the same, and we're not going to let the women by with something we don't let the men by with or vice versa."[64] On the surface, that made sense. But Huntoon was concerned about how the older generation at NASA would deal with the incoming women astronaut candidates. She warned them, "Don't go start trying to make [the women] into something, some caricature of an astronaut because you've got in your mind what a female astronaut ought to look like."[65]

Huntoon went to the women's defense more times than the women probably ever knew. One day someone asked her, "Did you see what [unnamed woman] had on today? She had on a pair of jeans and a t-shirt!" Huntoon replied, "Well, what did Tom, Dick, and Harry have on?" "Well, they had on jeans and a t-shirt, too." Huntoon rested her case.[66] For integration to work, double standards had to disappear.

Kathy Sullivan generously acknowledged the interference that Huntoon ran for the first six:

> She had been the voice of sanity on our behalf. The previously all-guy world said, "Well, what's the dress code for women astronauts?" "Well, what's the dress code for the guys?" "Oh, gosh, there isn't one. You couldn't ever tell a guy what to wear. But what if [the women] wear inappropriate things?" "Well, what if a guy wears inappropriate things?" "Well, I guess there's not a dress code." "Well, I guess that's right." "Well, what if their husband doesn't want to move?" "Well, what if his *wife* doesn't want to move?" "Oh, I think they'd just figure that out." "Well, their marital business I guess is just their marital business." She ran a bunch of this "manly jack" kind of thing with these guys.[67]

Huntoon admitted that she, like others in middle management, noticed generational distinctions between herself and the new ASCANs. But despite the differences, Huntoon remained adamant that the disparate expectations for men and women must not continue at NASA.

The time that astronaut candidates spent learning and studying did not really give them the opportunity to show what they knew and could do. That only happened once the ASCANs began to take on job assignments. While Carolyn Huntoon fought little battles over the dress code and hair dryers for the women when they first arrived at JSC, her biggest concern was to make sure the women got a shot at the most sought-after assignments.

ASCANs began to take on technical assignments six months into the training process and continued in such jobs after they were promoted to full-fledged astronaut status but had yet to start training for a flight. Huntoon noted, "Not every job was a great job, but they had to be done. My point was to give them the chance at some of the good ones as well as the not-so-good ones."[68] Huntoon advocated no special treatment but also insisted on no discrimination or holding the women to a different or higher standard. She received a call one day about the behavior of one of the female astronauts in a meeting. The call came from someone who complained, "She was just really hard on somebody." Huntoon asked, "Was she right?" The caller answered, "Yes." Huntoon had to explain that this very smart woman (as Huntoon argued was true for every member of the class of 1978) probably just thought she was as smart as the man with whom she had the argument.[69] Beginning on January 16, 1978, the day the names and profiles of the class members were revealed, Chris Kraft said that the women would get the same treatment

and be held to the same standards as the men. In asking the women whether that was the case, they argued that it was.[70] But from time to time, those gender stereotypes and double standards did surface.

When the women started getting flight assignments and training for their missions, a new round of adjustment began. With each "female first," people at NASA had to find new coping mechanisms. When Sally Ride was training for the first Shuttle flight to include an American female astronaut, Kathy Sullivan noted that Ride was careful about setting precedents and establishing procedures that others might view as the generally "female way." Sullivan recalled, "The first time a woman does a spec[ifications] review, she [Sally] would grab one of us who happened to be around and say, 'come on along,' just to help make sure that it wasn't too completely just wrapped around her, and would set any of us up the next time through to have to ask for or demand a change in something."[71] How Ride chose to handle the first flight could have had significant ramifications for the other women astronauts. She understood that her choices would be seen as a precedent that would be difficult to change. Sullivan lamented, "A guy coming in and making noise or throwing a tantrum to have a suit or a stowage adjusted the way he wanted it for his flight was kind of the norm. But the first time the next woman astronaut does that, you just kind of know somebody's going to say, 'See, I told you the girls were going to do this all the time!' "[72]

Sullivan felt the same about the EVAs that affected her aboard STS-41G. She observed, "Story Musgrave is quite renowned as a 'space walker par excellence,' a spacesuit kind of guy from way back when, and he and Don Peterson did the first EVA in the Space Shuttle suit. Story thrashed and wrestled for a really long time to get the lock-down knob unloosened on the stupid old foot restraint. He came back and said, you know, we can't tire out a whole guy's arm getting the damn foot restraint loose when there's seven more hours worth of stuff to do. Why are we tightening things down so hard?" Sullivan surmised, "It is probably to the net good of women doing space walks or in the space program that it happened to Story because it was unequivocally just a question of common sense. If it had been me or any other woman raising the question, someone would have been invited to question it. 'See, told you, when the girls come, we're going to have to do things their way.' "[73] Whatever the women did, good or bad, they understood that they were setting precedents, and they respected the responsibility that went along with their roles as the first women astronauts. Until the culture at

NASA could see beyond their sex and acknowledge them as just astronauts, *everything* the first six did was open for scrutiny.

Besides the six women, those most influenced by the inclusion of women in Group VIII were the other twenty-nine class members. Some of the men were as young as the youngest women selected (Sally Ride and Kathy Sullivan were both 26 when they were selected); the oldest was four years older than the oldest woman (Shannon Lucid was 35 years old and was the ninth oldest in the class). Somehow they all seemed to accept that the women earned their positions, and that the class was only whole when everyone was treated as an equal member. Early on in training, the public emphasis on the women did create a little tension, as evidenced by the lament, "We're mere commoners," during water survival.[74] Further, the men of Group VIII were still products of American culture. John Creighton, one of the pilot-astronaut candidates, admitted, "As a military pilot, I never had to work with women, period. I had to adjust to viewing women not as social creatures, but as fellow workers."[75] But when the class named itself the "thirty-five new guys," the moniker suggesting that the men of the class considered the women to be one of the guys was true to the mark.

Initially the men desired the same attention the women were getting from the press, but before long they were publicly defending the argument that the women were making—that they had earned their places in the astronaut corps and did their jobs just like the men. Kathy Sullivan explained, "I remember John Fabian's response at one point when there was some early discussion of journalists and other [people] flying. Somebody raised the question, 'Would it make any difference whether some female journalist flew before some of these gals?' I recall John saying, 'Yeah, it would matter!' " She remembered Fabian explaining, " 'They earned their way here, built the road, and are marching down it. And yeah, it would matter to me if they don't get to fly before some other women go to fly.' "[76]

As was typical with each class, the thirty-five new guys bonded and supported one another professionally and personally. When the women started flying on Shuttle missions and the media once again focused its attention on the women, male crew members did what they could to emphasize to the media that the women did their jobs not as *women* astronauts, but simply as astronauts.[77] With respect to attitudes about women coworkers, the male astronauts had come around to see that the job was sexless—and proven by the first six women to be genderless as well.

While the 1960s was a decade of frenetic activity for NASA trying to get to the Moon and back, the 1970s, with the changing chemistry of the astronaut corps, brought different kinds of stresses to those working at JSC. As Carolyn Huntoon's experiences and observations attested, the idea of bringing women into the astronaut corps was not something that many JSC people handled well. Although the nation's laws had changed to prevent discrimination against women, the laws could not teach NASA as an agency how to adjust to those changes or how to retrain its employees to cope with a new social order. Most NASA employees grew more comfortable having women astronauts once they saw the women doing their jobs. Those doubters began to understand that very little really had to change. For a few others, as Huntoon said, they simply continued to do their jobs and worked toward retirement without ever really coming to terms with the new look of the workforce.

Generally, JSC adjusted well, but the engineering adaptations and accommodations that the NASA engineers faced to make it *possible* for women and men to fly together in space added an entirely new dimension to the sexual integration of the astronaut corps.

CHAPTER 6

Defying Gravity

Even before Alan Shepard's suborbital flight on May 5, 1961, NASA engineers and physicians spent a lot of time, energy, and resources trying to answer the question of how to put a person into space safely. With the Soviet Union's flights of Yuri Gagarin and Valentina Tereshkova in the early 1960s, the world learned that both a man and a woman could survive spaceflight. But when NASA was finally in a position to put women in space and put men and women in space together, the unanswered—rather, unasked—questions about how to do it came to the forefront.

Despite plenty of proof that women could do the same jobs as men, men and women will always be different with respect to physical form and appearance. Even considering general body shape, it is wrong for engineers to assume that they can design equipment for women as if they are simply small men. The greatest challenge of integrating women into NASA's astronaut corps, second only to changing attitudes, lay in engineering the space suits, the escape systems, and the personal hygiene gear for women. Although it can be argued that sexually integrating the astronaut corps made the job of putting astronauts into space more complex, what is also true is that integrating women as astronauts also pushed forward the process of development and innovation. In accommodating women's needs, the engineers in the end actually developed simpler and safer methods of accommodating the men's needs as well.

On June 18, 1983, Sally Ride became the first American woman in space. By then, the women's movement had been going on for at least fifteen years and the Equal Employment Opportunity legislation of 1972 had been in force for over eleven. But those realities meant little when it came to many people's ideas about personal privacy and propriety. By 1980, marked by the election of President Ronald Reagan, the American majority (the voting majority at least) had embraced neoconservatism along with the antifeminist

rhetoric of Phyllis Schlafly.[1] By the end of the twentieth century, more Americans identified themselves as evangelical Christians or traditionalist in their religious beliefs. Over twenty-five years after Ride's first flight, many Americans still identify morality with sexual Puritanism and view any challenge to heteronormativity and male dominance as disorderly, immoral, and dangerous. Nevertheless, sociologists still acknowledge that "sexual bantering, flirting, and dating are commonplace at work."[2] In this context of conservatism and resurgent Puritanism, one cannot imagine NASA being anything but very careful about trying to project a strong image of respect for gender hierarchy. With the introduction of women to the flight rotation, NASA also faced the challenge of designing Shuttle architecture and flight procedures that would comply with American sensibilities.

American sensibilities about women flying aboard the Space Shuttle had less to do with women doing the job or men and women simply sharing a workspace than to do with men and women being confined together twenty-four hours a day. The Shuttle did not provide an environment for coming home after a long day at the office and slipping into something more comfortable, the idea Americans mistakenly identified with a traditional workplace. Any rest and relaxation the astronauts enjoyed, they did so surrounded by their coworkers. As with life on a military or research vessel out to sea for weeks or months at a time, coworkers served as each other's social network. The U.S. Navy was forced to address this same issue in the early 1990s. When Congress was debating letting women participate in combat positions, the idea that men and women would be expected to *live* with one another aboard combat vessels raised a lot of concerns and nearly sank women's hopes for serving in these positions.[3] The moral concern over such a situation was that sexually integrating the military, the astronaut corps, or any work environment that would require employees to spend an extended amount of time together might create undue sexual tension (or worse, its release!). In the 1950s, a few Americans encouraged putting a woman into space with men as a sort of "space prostitute," someone who could provide the male astronauts with an outlet for their stress and sexual needs on a long flight such as a trip to Mars. By the late 1970s and early 1980s, American attitudes about women and sexual equality had changed enough that such a comment likely would have provoked attacks from any number of feminist leaders and social groups. By 1978 when Group VIII was selected, it was clear that *all* the astronauts were there to do a job. But if women and men were put together

aboard the Shuttle, some Americans still wondered if "boys would be boys." Friendships might become something more if men and women were left together in a confined space for days on end: whether the astronauts would engage in sexual relations during a mission or not, NASA knew that putting men and women together aboard the Space Shuttle would lead to the type of controversial talk a federal agency could not afford.

When its engineers and contractors were designing the Space Shuttle, NASA put a lot of emphasis on what was called "privacy." In July 1995, NASA revised its handbook of guidelines for human factors engineering. Known as NASA Standard 3000, the tome outlined the requirements, policies, and specifications for designing suits, hardware, equipment, and architecture for the Shuttle (and later the International Space Station). With respect to privacy, the Standard stated, "There are cultural and individual requirements that should be considered. Certain personal activities such as sleeping, personal hygiene, waste management, and personnel interactions require some degree of privacy. These private areas should not be placed in passageways or highly congested activity centers."[4] This policy certainly reflects 1995 attitudes about privacy. But privacy concerns were no less important to NASA in the early 1970s when it was designing the Shuttle that would carry a sexually integrated crew.

Carolyn Huntoon made it clear that the JSC's administration was determined to treat the women in the same way that they treated the men. If this were the case, then making privacy a priority during the design process should have occurred regardless of whether women astronauts would be on board. The designers responsible for the habitability of the Shuttle knew that privacy was important, but they treated it as a human issue, not a "male versus female" issue. Allen Louviere, Chief of the Engineering Technology Branch in Houston, wrote a letter in January 1972 emphasizing the importance of privacy on orbiting spacecraft, while never mentioning the possibility of women on board. Louviere listed certain criteria "which cannot be placed in mathematical terms [that] were derived from the preference of crewmen who are highly motivated."[5] The criteria included an "enclosed hygiene/toilet component," "provisions for privacy without isolations," and an "interchangeable interior." "Each person should have ready access to privacy as well as social relationships with other personnel at his option," Louviere wrote. In addition, "movable partitions, modularized appointments, and variable lighting should be utilized to satisfy personal arrangements and accommodate

different functions, e.g. dining, recreation, sleeping, etc."[6] Essentially, the men were entitled to the same privacy from each other as the women. The NASA Standard 3000, which came to serve as the bible for all the engineers who worked on human interfaces, listed "privacy" time and again as a priority design criterion that must be considered when making design decisions.[7] In a spacecraft, however, with limited room and inflexible weight restrictions, sometimes privacy had to be sacrificed. NASA knew what the Shuttle *should* have with respect to habitability. Making it all work was the challenge.

In a document from early January 1973, C. C. Johnson, chief of the Spacecraft Design Division, spotlighted habitability as a concern for the Shuttle designers when he wrote, "I began marking your marked copy of subject document when I realized that the document is different from any other system's space by reason that there is no such thing as a 'habitability' system, per se—we can only specify guidelines that influence the definition of performance and interface specification for the individual hardware systems that make a habitable spacecraft. Okay—so let's set forth the habitability requirements and let the subsystem managers see to it that their hardware will provide same."[8]

Louviere's January 1972 letter laid out the elements of habitability for the Shuttle. But defining "habitability requirements" was more difficult than just making sure the Shuttle provided adequate life support. Johnson wrote, "Avoid non-quantitative or non-definitive motherhood statements that really tell the subsystem's man nothing more than he now knows," "avoid explanations and rationale," and "avoid specification. If you don't really know, say nothing. Your guess isn't any better than the next man's."[9] Certainly not having strict habitability requirements gave the engineers more freedom and opportunity to be creative with their designs. But making everything work for both sexes and still fit on board was the hard part.

One design element that NASA and the Shuttle contractors at Rockwell International (the contractor for the orbiters) had to sacrifice to some degree was individual sleeping berths. NASA's vision for the Shuttle's sleep stations developed out of its experience with *Skylab*. The *Skylab* berths were equipped with a sleeping bag, a small music system, and individual light and environmental controls, all in an enclosed space about the size of a telephone booth. The sleeping accommodations did not offer much room to spread out, but they did give the astronauts some privacy and quiet. The difference between *Skylab* and the Shuttle, however, was that only three astronauts flew aboard

Skylab at any one time whereas the Shuttle would eventually carry seven. In addition, *Skylab*'s habitable space measured 9,550 cubic feet compared to the Shuttle's 2,525 cubic feet.[10] Space was a commodity that *Skylab* had and the Shuttle really did not.

In June 1974 E. P. Smith, Rockwell's Chief Program Engineer on the Shuttle project, wrote to Aaron Cohen, NASA's manager for the Space Shuttle, asking for some clarification about the technical requirements for the sleeping bunks. Smith and his engineering team needed more information about things like sleep station configuration, orientation, and size; privacy requirements and volume per "man"; sleeping surface firmness and the effects that movement in one sleep station may have on adjacent sleepers; individual or combined sleep station closeout curtains, and to what extent these were to be lightproof; temporary stowage bags or straps in each sleep station for personal articles; restraint or retention straps required if a sleep station was used as an off-duty personal area; and stowage requirements for the sleep station when they were not in use, including whether they should extend and stow individually or as a unit.[11] As with all engineering tasks, the engineers worked to design something that best met the criteria. But issues of cost, time, efficiency, and—with the Shuttle—size and weight demanded some compromises. NASA worked hard to ensure that the astronauts could have their privacy and maintain their modesty. Providing sleeping bunks was part of that strategy. But given the design and engineering restraints, the Shuttle engineers found that the lack of physical space on the Shuttle's mid-deck ultimately dictated the design of the sleeping accommodations.

When the Shuttle started flying in 1981, it could carry up to four bunks. Mounted on the starboard bulkhead of the mid-deck, three bunks lay horizontally and one stood vertically near the access to the flight deck. The bunks each had a sleeping pallet, sleep restraints to keep the astronaut and bed sheets from floating away, a pillow, a light, ventilation ducts, a fan, a communication system, and a sound suppression blanket.[12] The sleep stations provided the privacy that NASA wanted, but the bunks took up a lot of room. Consequently, the crews usually flew without the bunks at all. Ultimately, NASA completely did away with the sleeping bunks in the Shuttle mid-deck. The astronauts valued elbow room over privacy.

The irony of the sleeping bunks is that the only time the Shuttle crews even had them on board was when the crews were at maximum size, when space was a premium. Instead of the bunks serving as a privacy accommoda-

tion, they actually served as a respite when Shuttle missions were divided into two shifts. The practice is called "hot bunking," or two astronauts sharing one bunk.[13] Because one shift's sleep cycle overlapped with the second shift's work cycle, the bunks were seen as the best way to ensure that conditions remained quiet and dark enough for crew members to sleep.

On flights when everyone was bedded down at the same time and no sleeping berths were installed, the crew members slept wherever they could. NASA's primary alternative to the bunks had been sleeping bags that the astronauts simply strapped to the walls. On STS-41G, the first Shuttle mission to have two women aboard, Bob Crippen slept in the commander's seat on the flight deck, Sally Ride slept in the pilot's seat, and Kathy Sullivan bunked behind them on the aft flight deck. Downstairs, Dave Leestma and Paul Scully-Power slipped into sleeping bags strapped to the starboard bulkhead and Marc Garneau floated free in an Apollo bag. Jon McBride, the pilot, snuggled between the two space suits in the airlock.[14] Without the privacy of individual sleeping berths, however, NASA astronauts did uncover a new issue—sleepwear.

At a meeting of the National Aviation–Space Education Convention, Robert Overmyer, NASA's deputy manager of construction for Space Shuttle *Columbia* and the pilot of STS-5, noted that with women participating in Shuttle flights, they needed to discuss the "problem of nightwear." Prior to STS-7 (Sally Ride's first flight), all of NASA's flights were all-male missions. Overmyer explained that on those flights the astronauts "usually just stripped down to their skivvies and slept wherever."[15] He said that the women had requested some sort of "nightie" to wear to bed in orbit and observed, "It does shed a different light on the subject of space flight."[16] JSC's crew systems office, which provided all the astronauts' wardrobes and suits, came up with a solution to the nighttime wardrobe problem by issuing gym shorts and a t-shirt to don at night.[17] If only all the problems could have had such a simple solution. But, as Carolyn Huntoon discovered when making the JSC training center ready for the female ASCANs, the question of appropriate sleepwear for every astronaut on board was not necessarily something that NASA officials had thought through. Pajamas were not much of an issue before women entered the astronaut corps. But the political and social ramifications of allowing the astronauts, male or female, to float undressed through the crew cabin when the opposite sex was aboard was not likely to instill much confidence in NASA's choices.

Wardrobes for the Shuttle astronauts turned out to be one of the simplest accommodations to make with respect to the introduction of women. The living accommodations on the Shuttle, like *Skylab*, were relatively comfortable. Because of the Shuttle's pressurized environment, astronauts abandoned the space suits that Mercury astronauts had to wear throughout the flight. With the exception of the one-piece flight suits that were worn during launch and landing (scrapped after the *Challenger* accident for specially made protective suits), NASA's preference was that all the clothes that the astronauts wore during orbit be comfortable and, if possible, commercially available.[18] Buying clothing off-the-rack for the Shuttle missions gave the astronauts some flexibility in terms of style and sizes, but also saved a lot of time and money designing and making specialty items for each astronaut.[19]

Even though NASA purchased essentially all of the astronauts' clothes from department stores, "engineering" the wardrobe still took time. Throughout 1983 to 1985, during which the first eight women astronauts flew (including Bonnie Dunbar and Mary Cleave, selected in the class of 1980, otherwise known as Group IX), the human factors engineers continued to tweak the clothing selection and their quantities based on comments the astronauts made during their debriefings after the missions. Other than not providing enough warm clothes for those astronauts who tended to get cold, the biggest problem with the astronauts' wardrobes was that their clothes were too tight, most often around the waist.[20] Some of the men found their pants to be so tight that they cut the elastic waistband to make them comfortable enough to wear.[21] Without laundry facilities on the Shuttle, the crew systems department had to pack everything the astronauts needed for the duration of the flight. Over time, those in crew systems at Johnson established a working wardrobe for the astronauts. Based on each astronaut's sex, according to the NASA Standard 3000, everyone was allotted one shirt for every two days of flight, one jacket for every two weeks, one pair of trousers per week, shorts or panties and a t-shirt or brassiere for every day, socks for every day, a handkerchief for every two days, two pairs of gym shorts and two exercise shirts for each week (one set for exercise, the other for sleeping), and a pair of slipper socks for every three months.[22]

Because NASA could buy so much of the astronauts' wardrobes retail, the introduction of women into the astronaut corps had little impact with respect to that aspect of crew systems. But all the astronauts did still have to change clothes. Despite the propensity in Hollywood films and television,

Americans are still very sensitive about nudity. As the 1983 flight of Sally Ride, America's first female astronaut, approached, journalists began publishing newspaper articles suggesting that people were concerned about how NASA and the astronauts were planning to handle interactions between the sexes.[23] Typically, instead of management dictating behavioral codes, crew members usually reached some agreement among themselves over how to handle issues of privacy. Kathy Sullivan, the first American woman to perform a spacewalk or extravehicular activity, recalled, "Every crew finds its own equilibrium with these things."[24]

In Sullivan's case, the issue of privacy came to a head when she and fellow spacewalker Dave Leestma met for their first EVA dress rehearsal. It quickly became apparent that no separate facilities had been provided for her to change into her Liquid Cooling and Ventilation Garment (LCVG), a suit of long underwear lined with tubes for running water to keep the astronaut from overheating in the protective outer suit. Surrounded by a room of male technicians, as Sullivan recalled, "We're standing side-by-side holding these things, and there suddenly was this unstated moment when you realize that this is the moment when normally the two guys just stripped down and get in their LCVGs with everybody standing around and nobody much cares." But this time was different because Kathy was a woman. Sullivan turned to Leestma and said, "Dave, let me tell you how I feel about modesty at a moment like this. I have none." Dave said, "Fine," and the two proceeded to disrobe. The technicians, on the other hand, were apparently unprepared to watch these two astronauts strip. As Sullivan remembered, the technicians could not leave the room fast enough.[25]

On the ground, the astronauts had their own restrooms, locker rooms, or a private changing area. When the Shuttle flew with the sleeping bunks in place, the astronauts at least could change their clothes in their bunk in private. But without the bunks, finding some privacy for doing anything more than using the toilet was difficult. The crews simply found their own ways to adjust. Sullivan said, "One crew of mine, because we didn't have bunks, . . . everybody mainly used the potty or the airlock when they were going to peel off their shirt or something. On another one of my crews, the guys or I would just say, 'I'm going to change my shirt.' The dynamic of *that* crew was that statement was a gentle announcement of a little preference for some privacy [but also] that there was not going to be some big hassle or embarrassment if somebody did turn around or come by me with my top off or a guy in his

skivvies."[26] The circumstances of close quarters forced the crews to suspend or even dismiss many of the concerns over privacy when changing clothes that they may or may not have maintained when on the ground.

The "shirtsleeve environment" aboard the Shuttle simplified any clothing issue that the introduction of women might have otherwise created. But to walk in space, as Kathy Sullivan did in October 1984, an astronaut needed specialized equipment. Suits designed for men simply did not fit women very well and remained one of the major restrictions to women's opportunities in space.

In the 1960s, when the idea of American women astronauts still remained a flickering hope, one academic cited the difficulties of designing a space suit for a woman as a strong reason for why NASA had not yet launched a woman into space. Dr. Harry Hess, a geology professor at Princeton and the chair of the National Academy of Science's Space Science Board, predicted in 1968, "It would cost us more than $100,000 just to redesign the space suit to fit the female anatomy." As a way of explaining the American problem, he added, "The Russians used their lady astronaut in a shirt-sleeve environment."[27] Once NASA started working on the Shuttle design, the engineers were able to start working on a new space suit for EVAs that agency officials hoped would be easier to don but also would cost less to build and fit more astronauts, including some of the women.

The key feature of the Shuttle-era suit was its modular design.[28] The main piece of the suit was the hard upper torso section, which served as a conduit to the primary life support system backpack and as the building block for the rest of the suit. The upper torso had four connector bearings: one at the neck, one below each shoulder, and one large bearing above the waist. To accommodate the largest number of astronauts, the rest of the suit was put together with suit sections of varying sizes for each part of the body. The arm section connected to the upper torso below the shoulder, and the gloves attached to the arm just above the wrist. The lower torso, or the suit pants, was made up of leg and foot sections that joined at the hip, the knee, and the ankle. Instead of making an entire EVA suit from scratch for each astronaut, the engineers simply assembled a suit with the prefabricated sections to fit an astronaut's individual shape and proportions.

In December 1978, six months into Group VIII's astronaut training, NASA released a news statement announcing that the engineers at Hamilton Standard, the company responsible for the suit design and production, were rede-

signing parts of the suit to "accommodate extra-small sizes for women."[29] Making the suit pieces smaller helped, but, anatomically, female astronauts needed more than just a smaller suit. Compared to men, women typically have narrower shoulders, wider hips, and larger breasts. Wider hips were not much of a problem; Hamilton Standard's size range of lower torso pieces usually met the need. But a woman's shoulders and breasts made the fit of the upper torso section difficult. The upper torso was a hard shell. So if an astronaut's arms did not fit into the armholes of the suit, his or her mobility likely would suffer. Given that almost all of the work the astronauts performed as part of an EVA involved one's arms, shoulders, neck, and hands, mobility and upper-body strength were crucial.

As one of her technical assignments, astronaut and physician Anna Fisher worked on space suit design. In her comments to the aerospace correspondent for the *Washington Star*, Fisher reported that smaller female astronauts found it difficult to move when wearing the suits designed to fit the men.[30] Specially tailored space suits made fitting the smaller women possible, but as Fisher further explained, performing an EVA would still tax their strength. When Kathy Sullivan performed the first spacewalk by an American woman on October 11, 1984, the *Washington Post* suggested that she might well be the last woman for a while to do so, based on the fact that she was the only female astronaut of the eight in the corps at the time who had been fitted for an EVA suit! "At 5 feet 6 and 150 pounds, she is also the most robust of the eight."[31] Sullivan's height and strength gave her an advantage as a spacewalker over the smaller women in her class.

As Anna Fisher stated, the smaller suits may have fit the smaller women well enough, but moving in them made it impractical for most women to perform a spacewalk. In fact, to move in a smaller suit actually requires greater strength, an attribute more developed in men than in women. Imagine the sleeve of a space suit as a spring. You can twist a spring to make the coil tighter. But if you cut the spring to shorten its unstretched length, and then tried to twist it, the task becomes harder to do. The principle was the same with a space suit sleeve: shorten the length between the shoulder and wrist bearings and it became harder to turn one's hand at the wrist. Since women tend to have shorter arms and less upper-body strength than men, the suits themselves actually restricted most of the women astronauts from participating in EVAs. Consequently, only ten women at NASA (Sullivan, Kathy Thornton, Linda Godwin, Tammy Jernigan, Peggy Whitson, Susan Helms, Heide-

marie Stefanyshyn-Piper, Sunita Williams, Nicole Stott, and Tracy Caldwell Dyson) have performed spacewalks.[32] That fact has not gone unnoticed by NASA. But the cost of fitting the suits for women is high. In 2002, budget restrictions forced NASA to stop work on a $16 million project to develop a new space suit for the smaller women. NASA's administration received both internal and public criticism for its decision to stop work on the suit, suggesting how important this project was to some.[33] But politically, when many continue to question spending money on the American space program when there are more pressing national problems, justifying a $16 million expenditure in a public forum on a project that only employs a small number of people (meaning only the astronauts) is as risky for NASA as spaceflight itself.

Until January 1986, the problem of fitting women into space suits only affected spacewalks. But in response to the *Challenger* accident, which killed Judy Resnik, one of the first female astronauts, along with six others, NASA started requiring everyone aboard the Shuttle to wear a protective suit during launch and reentry. Known as the LES (or Launch/Entry Suit), engineers designed the garment to protect against the loss of cabin pressure up to an altitude of 100,000 feet, cold atmospheric and water temperatures after bailing out of the Shuttle, and contaminated atmospheric conditions. The LES was also designed as a partial pressure suit, important during reentry.[34] After extended exposure to a microgravity environment, a person's blood tends to pool in his or her lower extremities. With a partial pressure suit, an astronaut's heart does not have to work as hard to keep blood flowing to the brain, thereby reducing the risk of fainting during and immediately following the Shuttle's return to Earth.

These suits, along with the new full pressure Advanced Crew Escape Suit (ACES) introduced in 1995, came in a range of sizes based on the U.S. Air Force twelve-size system from extra-extra small to extra-large tall.[35] The range of suit sizes accommodated all the variations in torso size within the astronaut corps, while whatever arm and leg length adjustments and circumference adjustments that were made could be concealed under the cover layers of the suit. With the range of sizes and the flexible material used to make the suit itself, it was possible to fit an LES and ACES for everyone in the astronaut corps.

NASA engineers designed the suits using a set of anthropometric standard measurements. Prior to the introduction of women into the astronaut corps, the astronauts' body types and sizes all fell between the 5th percentile and

95th percentile. Since women on average measured only 92 percent of the male size and weighed about 75 percent of the male weight, NASA had to expand its anthropometric standards for them.[36] According to NASA Standard 3000, agency engineers began designing suits to fit astronauts as small as the 5th percentile Japanese woman and as large as the 95th percentile American man, and later considered extending the smallest size to the 5th percentile East Indian woman.[37]

NASA introduced launch-entry suits, whether LES or ACES, as part of its intensified safety protocols following *Challenger*. As anyone who has worn a bulky winter coat and snow pants has realized, wearing thick extra layers made it difficult to move. For that reason, engineers knew that the key design factor for the launch-entry suits was mobility. Even the smallest astronaut needed to be mobile and flexible enough to get herself out of the Shuttle in an emergency. Along with the introduction of the new suits, the human factors engineers added the option of a special pair of gloves or an individualized tool that gave the astronaut the extra capacity she needed to escape from the Shuttle in an emergency. For Kalpana Chawla, the smallest person in the astronaut corps prior to the selection of the 2004 class, the crew systems engineers manufactured individualized gloves small enough to keep her fingers from backing out toward the palm section of the gloves when she moved her arms.[38] NASA designed the launch-entry suits effectively enough that the female astronauts reported very few problems with them.

When women first entered the astronaut corps, generally veteran human factors engineers felt that they would not need to make many accommodations with respect to gear and equipment for the women.[39] Over time, to fit smaller women, they came to realize that they needed to address one additional logistical problem. The LES and ACES were both one solid piece of material that covered all but the astronaut's head and hands. Because the suits all used one standard-size neck ring, as the suit sizes got smaller to accommodate a woman's narrower shoulders, the width of the shoulder section of the suit decreased. As part of the emergency egress procedures, every astronaut wore a parachute. But the small shoulder area made it difficult to secure a proper fit for the parachute harness. The easiest fix required the suit technicians to replace the existing neck ring with one of a smaller diameter. The helmet then needed to be made to fit the smaller ring as well. The engineers and technicians involved in the redesign did not see changing the neck ring size of an ACES as too problematic. But the women's presence

in the astronaut corps—whether it was because of their size, strength, anatomy, or cultural expectations—was seen as a problem, a challenge, or even a disruption that had to be addressed.

As with the suits, the kinds of adaptations that NASA has had to make for women astronauts were not always about modesty; some adaptations were strictly making sure the women could do their jobs safely and well. But there was one technical element of the Shuttle that brought functionality, safety, and modesty for male and female astronauts all to the forefront. How do the astronauts use the restroom? The ubiquitous lines outside women's public restrooms compared to the "drive thru service" available for men should be enough to demonstrate the different modalities of urinating. Because of limited space and weight restrictions, the Shuttle crews had to share a single toilet, so the toilet's design had to work for both sexes.

Hamilton Standard, a division of United Aircraft Company (now United Technologies) and a longtime contractor for NASA, ultimately won the contract to design the toilet for the Space Shuttle. Joseph Swider, an engineer at Hamilton Standard, outlined the challenges of such a job in an August 1972 news release. He explained, "Our astronauts have been using strapped-on tubes, bags, and even diapers for emergencies. . . . As soon as the shuttle was given a clear go-ahead, the people at NASA knew the old way just wouldn't do."[40] The news release identified the eventual participation of women in the Shuttle program as the reason why NASA wanted a new toilet design. "Aside from the inconvenience to people not trained as astronauts"—and for the Shuttle those people were the payload specialists who were not members of the astronaut corps but would still fly as mission-specific experts—"questions arose about safeguarding privacy in cramped spacecraft."[41]

On top of designing a space toilet effective for men and women, the engineers needed to think about the restraints of putting it aboard a spacecraft, specifically limits related to weight and size. Those requirements stimulated the designers to think unconventionally. One early proposal for the toilet came from the Loewy/Snaith Corporation. It was a "face the wall" configuration that the company's study found "was entirely acceptable to the user" and "more convenient to zero-gravity restraint than conventional, one-g configurations." Further, the toilet and hand-washing station could be reduced in width to fit within a thirty-inch compartment "without cramping the user."[42] With such a toilet, the astronaut slid into position from an opening above the unit and straddled the toilet as if he or she were riding a

horse. The design saved space and was enclosed behind a wall for privacy. The crew systems engineers chose not to select this design, most likely because they preferred to handle fecal material differently than urine. But C. C. Johnson, the chief of the Spacecraft Design Division, believed that the Loewy/Snaith design would have been workable and could have satisfied the anatomical and physical needs of both sexes while at the same time occupying only a limited amount of precious space on the orbiter's mid-deck.

Designing a toilet that both men and women could use in space was simple at some levels and complicated at others. Everyone knew what worked on Earth and understood intuitively what would work for men and women in space. Hamilton Standard's design for the Shuttle toilet closely resembled an airplane toilet. The seat had a more contoured shape, as well as restraints that swung across the legs to keep the astronaut from floating away. Both design features helped form a tighter seal between the seat and body than a ground-based or airplane toilet seat created. That was the easy part. The engineers' unique design challenge for the toilet was figuring out how to compensate for the absence of gravity, which did a good portion of the work when people urinate or defecate in a normal gravity environment. Gravity helped to pull urine and feces away from the body and into the plumbing. Hamilton Standard engineers designed a fan system for circulating air through gaps underneath the toilet seat down into the "waste containment system" (the sanitized NASA designation for the space toilet). When speaking at a science club workshop for the promotion of careers in science and engineering for girls, Sally Ride commented that the experience was like "sitting on a vacuum cleaner."[43]

In space, having a seal between the body and toilet seat was crucial to sanitation. The toilet's vacuum system needed to pull all the waste into the containment system for storage. Should the vacuum fail (which it did on occasion, particularly on STS-41G, Judy Resnik's first flight) or an astronaut forget to turn on the fans, urine and feces could float out of the commode and leave the astronaut with a less than pleasant cleanup job. Prior to development of a working space toilet (which was first introduced on *Skylab* in 1974), astronauts had relied on fecal bags for relief. A long plastic bag with adhesive around the opening for use in creating a seal, the fecal bag included a small sheathed protrusion near the opening of the bag that an astronaut could slide his finger into and direct feces away from his body and toward the base of the bag. The male astronauts viewed the fecal bags to be a reliable

and adequate, but not ideal, solution. But the Shuttle offered its crew a bit more space and some opportunity for privacy. Consequently, the Shuttle contractors made it a priority to design a toilet that would work well for all astronauts.

Creating a seal and preserving the airflow for the suction system were essential to making a space toilet work. Once the engineers had an effective prototype, they had to test it. Because the toilet needed to work for both men and women, both sexes had to participate in those tests. By 1972, NASA had a prototype but did not have a contingent of women that the agency could ask to fly aboard a zero-g airplane—a KC-135 known to the astronauts as the "Vomit Comet"—and try out the toilet. During the tests, the modified KC-135 flew in a series of parabolas. During the rapid descent portion of each parabola, the crew experienced weightlessness. Because weightlessness was such an unusual feeling, NASA wanted to conduct the testing with women "familiar with the flight environment, thus able to become comfortable quickly during the parabolic flight sequence and while working within the test protocol."[44] So NASA turned to the air force for help.[45] For three weeks in September 1972, four female flight nurses from Wright-Patterson AFB helped NASA test the proposed seat and waste collection system. In 1974 NASA repeated the tests on two modified prototypes, one from General Electric's space division and the second from Hamilton-Standard, both based on the evaluations and comments that the female nurses gave the engineers during the 1972 testing. Until NASA hired some female astronaut candidates that the engineers could use as test subjects, the nurses served as a positive and valuable alternative.

Based solely on its appearance, most people would likely be able to identify the Shuttle's waste containment system as a "space toilet." But the Shuttle's toilet served more than just its obvious function and consequently had some design characteristics not normally seen in an Earth-based toilet. Part of NASA's primary mission was to conduct scientific experiments involving the life sciences. In a letter from Charles Berry, longtime NASA director of Life Sciences, to Myron Malkin, director of the Shuttle program, Berry expressed his concern over the Shuttle's waste containment system's abilities to collect fecal and urine samples and provide the wet and dry mass data and volume measurements that the Life Science division needed to collect as part of its program of medical experiments.[46] Because the experiments usually needed urine and feces kept separate and the astronauts would be more

compliant to the experimental protocols if that process was made relatively easy and sanitary, the engineers designed the toilet to collect those waste products separately.[47]

The other factor in designing the collection process related to weight. All human waste has a high water content, which makes it heavy. By vacuum drying the solid waste and venting the liquid along with any urine not collected for testing and other wastewater into empty space, the astronauts could reduce the weight and volume of the waste they brought home. In order to separate the solid and liquid wastes, designers equipped the toilet with an external urination hose. Each astronaut had a personal funnel attachment to help direct his or her urine stream into the containment system. The male version of the funnel was just a simple cone. Because the space toilet used a suction device to replace gravity, the male astronauts did not "hard dock" with the funnel attachment.[48] With a little separation between the funnel and the penis, male astronauts found they could urinate without much need for cleanup.

Because women were not as physically capable as men of controlling the direction of their urine streams but still needed to use the urine hose for separation and collection purposes, the crew systems engineers needed to design special female urine collection funnels. To prevent a "space age mess," the best plan for women astronauts, indeed, was to "hard dock." Not only did the funnels need to fit a woman's anatomy, but they had to be designed with special slots to maintain the airflow for the suction system (the men were able to maintain that airflow simply by not making contact with the funnel). Eventually, the engineers in consultation with the original six women astronauts narrowed the options down to four funnel designs. One was conical, like the male funnel. The other two were variations of an oval. Rhea Seddon described the testing and evaluation process as "totally strange!"[49]

The only way to flight-test the funnels to see if they would work in a zero-g environment was to have the women try them out on the Vomit Comet. Seddon recounted,

> The [engineers] wanted to try several different designs. The problem is, of course, you've got this [very short] period of time [of weightlessness]. We talked about it ahead of time; we planned it out. You'd fill up your bladder before you left and hope there wasn't any delay in the take-off or in the line at the toilet. And then we'd each go in there and in 30-seconds, you wait, you get lined up, you get

> situated. Then when you're at 0-g, you pee. And of course again, it's hard to pee on cue. And then if it starts to leak, if you don't have a good seal, and you've got a full bladder, you're trying to stop. You can do that sort of. But then, do you restart? Do you wait for the pullout [at the bottom of the parabola]? Do you stay in there during the 2-g pullout? It was just kind of bizarre.[50]

The women had to repeat this exercise for each of the four funnel designs. Seddon recalled, "You try to pee early, get in one of the early parabolas. Then go back in the back and drink a whole bunch of stuff [and] hope you weren't sick. You try to fill yourself up with [more] urine, and then try it again."[51] Despite the benefits of being able to try out the waste containment system on board the KC-135, the real test of the funnels only came once they were in orbit. According to Seddon, "You had to get there and try it a few times and have plenty of tissues around so that if you didn't place it quite in the right place or have a good seal, you could mop up. Over the course of several days you got to be reasonably good at it. But it took some practice."[52]

When the Shuttle was finally ready for its first operational flight test (STS-1, in April 1981), the waste containment system got its first real trial run. Commander John Young and pilot Robert Crippen returned to Earth with moderate praises for the waste containment system, but they made it clear that the compartment housing the space toilet, even with a privacy curtain, left a lot to be desired. Young reported, "I don't think the WCS door holds any structure and I tell you if we're going to have women fly on this thing, they can't be modest because I don't see how you can use that thing and stay healthy on a reasonably long mission without taking every stitch you got off and clean yourself."[53] From the beginning of the Shuttle's development, the engineers envisioned some sort of privacy door or curtain for the toilet, but the flight report from STS-1 confirmed its importance. After every Shuttle flight, the crews participated in a technical debriefing when they reported back to the engineers and flight surgeons about habitability issues. Based on these reports, the engineers learned what needed to be adjusted, retrofitted, or completely abandoned in favor of a new design.[54]

Generally, the space toilet worked well enough with only minor glitches. On STS-8, the five-man crew reported, "The W[aste] C[ontainment] S[ystem] proved to be very easy to use in the urine collection mode. Although the airflow seemed adequate, there was usually some liquid remaining on the inside of the funnel after use that had to be cleaned up with tissue."[55] Sanita-

tion was part of the process that every astronaut had to perform. Rhea Seddon commented that everyone was courteous and respectful of their crewmates' desires for a clean and odor-free toilet. So wiping all the equipment free of any waste that the system did not collect on its own with biocidal towels was a must![56]

The handling of solid waste created additional problems. A device commonly called the "slinger" chopped up the feces and hurled it against the wall of the toilet's internal canister so that the waste had the largest surface area for freeze-drying. But chopping up the feces created "fecal dust." The STS-8 crew reported, "From the first five flight days, the WCS worked well in the slinger mode. The crew was very conservative in use of tissues, since the presence of significant amounts of tissue in the slinger had been blamed for causing problems on previous flights."[57] It was clear after just a few flights that the astronauts needed to adjust their Earth-based practices of simply "flushing" all their used toilet paper. The toilet simply could not process all the additional material. Instead, they stowed most of the used wipes in sealed bags that they disposed of after landing, only flushing the bare minimum of tissue. The slinger, however, still struggled. The flight report continued,

> Commencing the morning of flight day 6, the slinger began making sounds which led the crew to believe that solid materials were loose and being slung around within the cavity. Several crewmembers also noticed particles floating or being ejected from the gate valve area. These particles varied in size from dust to centimeter size and the larger ones were encountered outside the WCS area. Later that day, the slinger began laboring during use and continued to do so until WCS closeout on entry day. Although the slinger was still functional, the crew was concerned about WCS health had the flight duration been extended a day or two.[58]

As flights got longer and NASA looked forward to the construction of a Space Station (construction on the International Space Station began in November 1998), the engineers found these reports to be invaluable for retooling the Shuttle's toilet for future designs.

Unfortunately, when things went wrong with the toilet, they went very wrong for women. On STS-41D, Judy Resnik's first flight, the toilet completely failed on the fourth day of the seven-day flight. As the flight crew report stated, "Urinal op[eration]s were terminated the evening of flight day 4 due to the inability to dump the waste tank. Apollo fecal collection bags and

some emesis bags were utilized for urine collection the remainder of the mission. These bags were found to be totally unacceptable for this purpose, and a different backup urine collection scheme needs to be devised." While the men could physically urinate into the bags, they did experience a lot of splashing. They solved the problem by putting a dirty sock in the bottom of each bag to serve as an absorbent. The bags, however, did not work for Resnik. Her best option was to urinate directly onto a towel that she could hold in place and then dispose of it in one of the bags. The situation was far from acceptable, and the astronauts pushed for a better contingency plan to be put in place. But male and female astronauts alike will suffer through a considerable amount of unpleasantness to stay in orbit for one more day.

Designing a toilet for the Shuttle that would accommodate both men and women was challenging enough. But an even bigger challenge—and a more interesting problem from a historical and social perspective—was how to handle urine collection for women during launch, reentry, and EVA, all times when the astronauts did not have access to the space toilet. Since the Mercury era, the men wore an external catheter device connected to a urine collection bag, which they continued to wear on the Shuttle. But the women needed something different. One of the early design concepts for a similar external device for women resembled the feminine napkin belts worn by women into the 1970s. When Joe Kosmo, one of the human factors engineers at Johnson Space Center, saw these sketches in 2004, for the first time in three decades, he said with some apparent embarrassment and regret, "Oh, yeah. I remember that."[59] Rhea Seddon wrote of them, "Borrowed from chastity belt designs for sure!"[60]

Most Americans would laugh and many women might cringe at the design of this female urine collection device (UCD). It consisted of a contoured funnel made of hard plastic that was held in place close to the astronaut's urethral orifice by the support briefs. On the surface, this design embodied every good intention among NASA engineers to accommodate women astronauts —it was noninvasive, and it mimicked the UCD with its external cuff and tube attachment that the men had been using. At the same time, it seems that none of the male engineers assigned to this project felt comfortable enough to consult a woman first. Despite the awkward appearance, one of the major design criteria for the female urine collector actually was comfort.

Once it was clear that women would be included in the Shuttle program, the human factors engineers knew they needed to start developing some

system for female urine collection. But getting started was more difficult at the time than it sounds. They turned first to the medical community, looking at solutions for incontinence. But often those techniques, such as a catheter, were invasive. In addition to discomfort for the astronauts, the flight surgeons would have likely vetoed the idea because of the increased risk of infection. Devising a noninvasive system, however, also had its problems. As Joe Kosmo admitted, the engineers were not very knowledgeable about female anatomy and relied on speculations about how a woman's urine stream behaved in zero-g. To solve the problem, air force flight nurses, again, volunteered to "pee for posterity" aboard the Vomit Comet, urinating while camera crews filmed how the urine reacted in a microgravity environment.[61] Understandably, NASA's public affairs office did not announce this experiment publicly.

Step one to designing a UCD for the women astronauts was learning how urine behaved in zero-g. Step two was understanding a woman's anatomy well enough to design an apparatus that would function. One female engineer a generation younger than Kosmo asked about the men's apparent ignorance of female genitalia, "Didn't you have wives?" He replied, "We didn't look!"[62] Despite some of the strides made during the sexual revolution in the understanding and awareness of women's bodies and health, these male employees at NASA had grown up during the 1950s with its rather strict expectations of modesty even within intimate relationships. The whole idea of designing intimate technologies for the women astronauts caught the engineers a bit off guard, and initially they dealt with it through banter and occasionally some off-color humor, in other words, by evasion. One engineer used the plaster model of female genitalia that sat on his desk as a pencil holder.[63] But despite how poorly American culture had prepared them to handle this sexually charged engineering task, they still had to develop something that the women could use.

Based on conversations they held with the women astronauts, the engineers rejected the so-called chastity belt design. For the design to work, it needed to keep a fairly tight seal. The women astronauts were not convinced that the device would stay in place well enough to be effective. Not everyone completely abandoned the concept, however. In November 1979 Terence Finn from NASA's Office of Legislative Affairs responded to an inquiry from U.S. representative Ron Paul about the Female Urine Incontinence Collection Apparatus (FEMUICA). Finn explained that the FEMUICA was a spin-

off from the materials and processing technologies for custom-fitted earpieces the astronauts used in their communications headgear.

NASA applied for two patents in 1978 and 1979 and hoped to market it as a health care device for the handicapped and elderly.[64] Ultimately the engineers proposed to the women astronauts that they try a diaper-like garment called the Disposable Absorption Containment Trunk (DACT). Looking like a pair of super-padded bicycle shorts, the DACT offered the women more security and gave them more confidence that the garment would work no matter what position they were in or how much they moved. In hindsight, this seems like an obvious choice given that all astronauts today regardless of their sex wear a similar device. But at the time, there were real technological and cultural hurdles to the diaper design. From a technical perspective, while NASA engineers were trying to design a UCD suitable for women astronauts, the U.S. Department of Agriculture was still developing the absorbent material for use in trapping water in otherwise arid soil that eventually made the space diapers feasible.[65] In addition, adults preferred to use an uncomfortable UCD over a diaper, which they viewed as embarrassing and humiliating. In his book *Eyeball to Eyeball: The Inside Story of the Cuban Missile Crisis*, Dino Brugioni discussed how U-2 pilots felt about wearing diapers. He wrote, "There are provisions for urinating in flight but no provisions for defecating once strapped into the cockpit. In the early phases of U-2 flight training, pilots were offered diapers, but all felt that this was demeaning and chose the high-protein, low-bulk meals as an alternative."[66] Diapers were degrading. But for the women astronauts, the DACT seemed like the most practical option. After all, they wanted something that they could trust would work when they needed it. So, they were willing to test them.

Rhea Seddon remembers testing the DACT for the first time. She described the experience as successful, but definitely a little weird. "I took mine home and both stood and laid down in the bathtub and finally could convince myself to wet my pants. Believe it or not, that's hard to do. I actually was glad that I [had tested the DACT] because it gave me confidence sitting on the pad that it was going to work."[67] The absorbent material used in the DACT to trap fluid—just like the material developed by the USDA—turned into a gel when it got wet. Seddon commented with a chuckle, "It felt like you were sitting in a pile of JELL-O."[68]

Ironically, because the women astronauts had tested the DACT on Earth, they were at some level better prepared for spaceflight than the male rookie

astronauts. Seddon postulated, "I think a lot of the guys had this horrible realization when they were lying on the pad that they either psychologically or physically could not pee on their back."[69] The men were well aware that they would be fitted with an external catheter connected to a collection bag for launch. As this essentially was the same system in use since the Mercury program, the male astronauts spent very little time practicing with it. Seddon said, "It just looked like it worked. So I think some of them had a rude awakening lying on the pad with a very, very full bladder and not being able to sit up or stand up to relieve themselves."[70] Laughing, she concluded, "You know when people say, 'Are women better at some things than men?' Probably peeing lying on their backs is one of them!"[71]

Because the DACT was so successful and adult diapers were becoming available in drug and discount stores at prices much lower than anything NASA could produce on its own, all the astronauts began to opt for a diaper instead of a catheter. Historians may speculate as to whether male astronauts would have made the switch on their own or when they would have transitioned to the new technology had women not entered the astronaut program when they did. But most would likely argue that the technologies NASA's engineers developed for the first group of female astronauts ultimately benefited the entire corps' flight experiences.

Throughout the Shuttle era, new gender- or sex-specific issues came up that either the astronaut office or the engineers needed to address. When the engineers designed the seats for the Shuttle, they paid particular attention to making sure that women would fit without compromising safety.[72] During the Space Station design phase, they focused on the architectural dimensions. In zero-g, an astronaut does not use his or her legs much, so their legs are often very relaxed and float naturally as if in a partially seated position. Consequently, taller astronauts fit into a smaller space than they would on Earth. By the same logic, the smaller astronauts benefited from smaller architecture. According to NASA Standard 3000, the aim was for all workstations "to meet the functional reach limits of the smaller of the defined crewmember size range and yet shall not constrict or confine the body envelope of the larger of the defined crewmember size range."[73] Because women were generally smaller than men, women astronauts were naturally better suited to the architecture of both the Shuttle and the Space Station.

One cultural issue that ultimately became a concern for the astronaut office was hair. When the Group VIII women were still ASCANs, the astro-

naut office chose not to issue a policy that would dictate hairstyles for any of the astronauts. But when Marsha Ivins, known for her long hair, flew aboard STS-32 in 1990, people outside of NASA took notice of the problem. One of Ivins's crewmates snapped a photograph of her with a huge halo of hair floating around her head. An industrial safety engineer who saw the picture in the newspaper wrote to NASA, expressing his concern that Ivins's untethered hair created a danger of getting tangled in equipment.[74] Despite the astronaut office's previous hesitance about dictating a policy on hair, Donald Puddy, the Flight Crew Operations Director, felt obliged to issue a memo to all the astronauts that hair "long enough to present an obvious hazard" must be tied back during flight.[75] Although, to date, the hair policy has only been a factor for the female astronauts (none of the male astronauts have grown their hair long), the fact that NASA has been dictating policy and making changes only when the issue truly becomes an issue of safety is a positive sign of how the politics and logistics of women in the astronaut corps have developed since the 1970s.

The changes and adaptations that NASA has made to its vehicles, hardware, and policies for women have been extensive. The challenges of space make any human excursion difficult and demanding. Each time engineers had to design single pieces of space-based equipment that would work for both male and female bodies, the complications grew. On top of functionality, NASA engineers also had to think about propriety. It is probable that not every astronaut wife or husband was thrilled about her or his spouse spending extended lengths of time in relatively close quarters with the opposite sex. It is also likely that not every American was thrilled with the idea of sending unmarried people into space without the benefit of much privacy. But as an agency, NASA and its design teams addressed those problems within an agency-wide organizational context that proved generally responsive.

CHAPTER 7

"NASA Sutra"

When NASA's administrators made the decision to include women in the astronaut corps, probably few people truly were aware of all the potential consequences of such a move. Developing the hardware and equipment was definitely challenging, but not nearly as controversial as the social ramifications of mixed-sex crews and female astronauts for NASA's long-term human space agenda. As NASA moves toward longer-duration flights, extended stays aboard the International Space Station, missions to Mars and nearby asteroids, and presumably colonization of the Moon or other planets, the agency will have to explore more deeply the issues of health and sexuality. In turn, how NASA has handled these matters can be used to analyze the agency's legacy with regard to the integration of female astronauts.

In November 1998, John Glenn completed his second flight in space. This time, instead of orbiting the Earth in a one-person Mercury spacecraft, Glenn served as a payload specialist aboard the Space Shuttle *Discovery*. NASA justified his selection as a crew member of STS-95 by his advanced age. At 77 years old, Glenn made a good test subject for medical experiments that would hopefully yield valuable data about health concerns for the country's older population. That factor and the public affairs success story of returning one of America's great heroes to space seemed justification enough to send Glenn up one more time. The problem was that the combination of medicine and public affairs did not apparently hold as an argument for sending women into space.

In March 1999, four months after Glenn's flight, Dr. Arnauld Nicogossian, NASA's chief life scientist, proposed a mission with an all-female Space Shuttle crew. The rationalization that he shared with the press as his reason for such a mission was science. A CNN news article explained, "With a new space station on the horizon and increasing talk of trips to Mars, NASA wants to make sure it protects the health of all its astronauts, male and female." The

report continued, "But just as with Earth-bound medical research, most of what it knows has been gleaned from men, and projecting results onto women could be dangerous."[1] The argument made sense. But proposing an all-female flight, particularly at a time when NASA was still enjoying the public success of John Glenn's return to space, caused some to ask whether this flight was really more than just a gimmick.[2] The subject became such a sensitive topic both inside and outside of NASA that by May 1999 only Nicogossian and NASA administrator Dan Goldin were authorized to discuss the proposal publicly. Goldin instructed everyone at JSC to refer all questions about an all-female Shuttle crew directly to NASA Headquarters.[3]

Historically NASA has performed better medical research on women than most organizations in the United States. In a June 1994 talk that Carolyn Huntoon, then JSC director, delivered at the 2nd Annual Women's Health and Space Luncheon, she stated, "Unlike so much of the research performed here on the ground, NASA is performing these investigations on both male and female astronauts." She noted, "Twenty-three women have been chosen for the astronaut corps since 1978. Nineteen have collectively spent more than 7,000 hours in the laboratory of space." Four of those women were medical doctors (Fisher, Seddon, Ellen Baker, selected in 1984; and Mae Jemison, the first African American female astronaut, selected in 1987).[4] Huntoon observed, "Their personal insights into the effects of microgravity on the female body have been invaluable and have laid the groundwork for future research."[5] In a 2002 interview, she argued that there was no better collection of medical data on women undergoing physiological changes than what NASA had compiled.[6]

Huntoon's analysis may well be correct. Beginning in 1978 when the first women astronauts arrived in Houston, a selected portion of every astronaut's medical data was included in the Longitudinal Study of Astronaut Health (LSAH) database. By 1999, NASA had begun compiling a second medical database called the Life Sciences Data Archive (LSDA).[7] But as astronaut and physician Rhea Seddon argued about that archive, it is very difficult to get enough good data that a doctor or researcher interested in medical issues affecting women can use effectively. "Usually there's only one woman on a flight. So you have to look at it long-term. [On top of that,] the flights are all different. Getting good information that you can look at across the group of women was going to be kind of hard." Seddon acknowledged, "We've gotten some information on my Spacelab flights. We had women [aboard] so that we

could maybe get women and men on the same flight, doing the same experiments. But it's just that we haven't made [women's health] a real focus."[8]

Once NASA made the announcement that it was considering an all-female crew, the agency then had to justify the flight. This is normal. Because each Shuttle launch cost an average of $450 million, every mission needed to be scientifically, militarily, or commercially justified.[9] Most flights, however, do not create the same kind of public interest that the all-female flight attracted. As *Washington Post* staff writer Kathy Sawyer observed, "After all, nobody makes a fuss about an all-*guy* flight."[10] According to Administrator Goldin, justifying the flight involved deciding whether there were research opportunities that merited a dedicated mission. NASA scientists would then design the experiments. Once the scientists determined the actual experiments for the flight, only then would the astronaut office assign the crew as test subjects, be it all male, all female, or a mixed crew.[11]

Immediately following the proposal's announcement, some women at NASA (as well as many private citizens) went on record about such a flight. Millie Hughes-Fulford, who flew as a biomedical payload specialist in June 1991 aboard STS-40, saw the flight as a great opportunity to learn whether women lose bone and calcium in space at the same rate as men. Former astronaut Kathryn Thorton (selected in 1984 and resigned from NASA in 1996 after flying four missions) worried that the women's privacy might be at risk. She said, "I don't know why it would be necessary to have them all on the same flight. Everyone would know these seven women on all these different tests."[12] Chief scientist for the International Space Station Kathryn Clark seemed torn: "If an all-female crew is selected to fly, I'm sure there will be great science on that mission. I just don't know that it would be better science than if it's an all-male crew or a mixed crew."[13]

As part of the evaluation process for an all-female flight, NASA called on the National Space Biological Research Institute (NSBRI) for help. The NSBRI sponsored an investigation on gender-specific space medicine. The team, led by physician and former astronaut Rhea Seddon (resigned from NASA in 1997), conducted a two-day workshop in Houston. The team evaluated NASA's knowledge base in human spaceflight, the status of current and proposed medical treatments for maintaining the astronauts' health during and after flight, training and flight procedures related to the astronauts' health, and human-machine interfaces, all with a special emphasis on gender- and sex-related questions.[14] The panel not only looked into what data NASA

had collected and archived about women's health and the agency's future plans, but also talked to a number of the active female astronauts about their willingness to participate in an all-female flight.[15] The final report, submitted to NASA on September 30, 1999, offered a somewhat frustrating picture of NASA's history regarding women's issues.

While opponents of the flight questioned whether microgravity even affected the sexes differently, the workshop members reported that a few of NASA's studies showed definite measurable differences between the sexes, specifically susceptibility to postflight orthostatic hypotension, a form of low blood pressure that a person experiences when rising from a prone or seated position.[16] But after twenty-one years of data collection on women's health—and sixteen years of flight data collection—the report read, "No spaceflight data exists but differences could be predicted for several symptoms (postmenopausal bone loss, iron intake requirements, muscle strength and endurance)." It continued, "In still other areas, spaceflight data has not been collected and prediction of gender differences is not possible but studying them is important for long term health, safety and performance (decompression sickness susceptibility, pharmacokinetics, immune function, radiation sensitivity, and psychosocial adaptation)."[17] The team argued that one of the most important reasons for NASA's life science research program was to understand the physiological changes that might affect an astronaut's performance and health once he or she returned to Earth, and that if physiological differences inherent to one's sex might lead to more effective treatment methods, NASA should investigate them.

The group understood that NASA could not dedicate extensive time to in-flight medical research for either men or women given the technical and financial limitations of the space program at that point in time. Ideally, the completion of the International Space Station would change that. But until then, NASA scientists emphasized ground-based research that included female subjects to draw some conclusions about the impact an astronaut's sex has on their health. But astronauts typically are not terribly interested in participating in medical experiments, a statement that holds true for both men and women. Based on conversations with other female astronauts and her own experiences in the corps, Rhea Seddon explained that the women astronauts were resistant to being singled out as guinea pigs. Seddon said, "Most astronauts don't really enjoy life science flights. They'd rather be doing docking missions, construction missions, big things."[18] But the women also

felt strongly about being treated as equals, and not as *women* astronauts. She confided that the women did not want a special flight "set aside" just for them. "In other words, men, you don't need to apply. They didn't want it to be that kind of a selection. They want to be part of the office. They want to be in the same rotation. They want to be considered for the same jobs."[19] Just as the first six women in the astronaut corps had insisted on equal treatment and equal opportunities with respect to flight assignments, so did the women who would have served on an all-female flight crew had that flight come to fruition.

In concluding their report, the workshop team stated, "There are several health care issues unique to the female astronaut population that NASA must address. A firm commitment to equipment and task design to optimize job performance and safety is required."[20] The health consequences of spaceflight may be extraordinarily important to study, but for the women astronauts, and consequently for NASA's administrators who had worked to get women into the space program, there was also a risk. If studies on sex differences showed that being an astronaut presented a greater health risk to women than men, NASA might feel forced to ground the women. The political consequences to NASA had the agency grounded the women in the late 1970s or early 1980s because they were the weaker sex—or at least the more vulnerable sex—likely would have been disastrous. Seddon explained, "I think to a certain extent, the reason that a lot of those [differences] hadn't been addressed is it was a nonissue. How are women different? Let's treat is as a nonissue until it becomes an issue." She continued, "Don't try to find out how women are weaker than men or how women are better than men. The women in the program just really didn't ever want that, especially early on when there was a question of whether women were going to make it in the space shuttle or not."[21] Seddon concluded that NASA did not want the women excluded because of what medical studies might have uncovered either. "NASA didn't want to fund a lot of studies to look at sex differences; it's a hot potato."[22]

In 1999, when Nicogossian proposed the all-female flight, one that essentially would be looking into sex differences, it was still a hot potato. The public's criticism of an all-female flight did not focus not on whether the potential sex-based or gender-based experiments were valid scientifically, but on whether it was really just a public affairs stunt. Sherry Marts, the scientific director of the Society for the Advancement of Women's Health Research,

argued that the flight would be a mistake if it exploited women for merely political or public relations purposes. "My fear is this (flight) would be just a feel-good mission. It may be that now that they've sent a senior citizen into space, it's time to send some women."[23] The unfortunate reality of this criticism was that an all-female flight *would* have been a great public affairs event for NASA and for women. Rhea Seddon understood the flight as just that. "After we had chosen some women pilot-types and after John Glenn had flown and we saw all of the interest in his flight, particularly in the older population, and the inspirational effects, [people at NASA said], 'Wow! NASA got a lot of good publicity about that. What else can we do?' And Arnauld said, 'I think we should have an all-female crew.' "[24] Even Dan Goldin agreed. "The fact that young girls will see an all-woman crew, I think, could be a huge inspiration and impact on the future of education." But he understood that "first we establish the science, then we establish the inspiration."[25]

No advocate of human spaceflight would be acting responsibly if he or she advocated *any* flight for public relations reasons alone. Even during the height of the space race, NASA was careful to use each flight as a technological and scientific learning experience. But in an environment where sending an entire crew of women into space on a mission dedicated to medical science could be justified by NASA's long-term human spaceflight agenda, it is unfortunate that such a mission has not materialized. One anonymous letter to the editor sent to the *Salt Lake Tribune* lamented that political and public pressure might result in NASA's decision against an all-female flight. It read, "An agency that already has sent two senators into orbit—former Utah Sen. Jake Garn and former astronaut and Ohio Sen. John Glenn, the latter ostensibly to study the effect of aging in a space environment—can hardly argue that it is not appropriate or that there is little or nothing that can be learned as a result [of an all-female flight]."[26]

One female letter writer from Syracuse, New York, wrote of the proposal, "This sounds like an effort to end sexism, but up until now medical research at NASA has been aimed at men. If women are to be truly recognized as competent astronauts, they must be placed in important roles in a coed space shuttle mission." She continued, "To end misconceptions and sexism, women should be in all flights not just being a leader on an all-women flight."[27] While the letter writer does seem unaware of the fact that NASA had been collecting medical data from women astronauts since 1983, that Eileen

Collins had already piloted the Space Shuttle *Discovery* (STS-63) in 1995, and that she was scheduled to command a flight aboard *Columbia* that July, her comments echo the arguments against an all-female flight made by the women astronauts themselves.[28] One agency insider observed that the female astronauts are "insulted by anything that smacks of gimmickry or implies their skills somehow don't measure up."[29]

When NASA administrator Jim Fletcher started pushing to get women into the astronaut corps, some throughout the NASA organization were concerned that the women might fail as astronauts. Therefore, NASA was quick to recognize the service and achievements of women as astronauts. In 1993, when then chief astronaut Robert "Hoot" Gibson felt he unintentionally gave the impression to *Space News* that women were being excluded from applying for flights aboard the Soviet space station *Mir*, he moved quickly to rectify the mistake. He wrote in a letter back to *Space News*, "We are justifiably very proud of the many contributions to the space program made by our women astronauts, both in the flight environment as well as in the flight planning, flight support, and management roles. The contributions made by women will certainly increase in the coming years and will include participation in the Mir missions."[30] Gibson's response gave credence to the argument that NASA valued its female astronauts. The decision not to fly an all-female mission in light of the negative press the proposal received further suggests that NASA believed that women astronauts were more than just show and resisted flying a mission that would suggest such a perspective.

Part of NASA's justification for not pursuing an all-female mission with more vigor can be traced back to the NSBRI workshop's final conclusions. Even with less than two full days to investigate the question of women's health in spaceflight, it was clear to the workshop participants that the agency needed to commit itself to addressing a number of concerns related to the health of its female astronauts and their job opportunities. But none of the recommendations actually required flying all-female crews.[31] That conclusion most certainly pleased the women in the astronaut corps.

Women astronauts had already provided valuable medical data through their participation in other missions. The two Spacelab Life Science missions (STS-40 in June 1991 and STS-58 in October–November 1993) that were dedicated solely to medical research included four female astronauts and produced five sets of female data (Rhea Seddon flew aboard both missions).[32]

Further, when astronaut Shannon Lucid returned from her 188-day stay in space aboard the Russian space station *Mir*, the information that she was able to provide the flight surgeons about exercise and bone and muscle loss consequently helped NASA's life science researchers develop new exercise techniques for the astronauts on long-duration flights.[33] Although the NSBRI workshop emphasized NASA's need to dedicate more attention to the potentially different health risks to male and female astronauts, if the agency continued to select and fly women at a rate at least representative of their numbers in the astronaut corps, the physicians and researchers should get enough information to make informed decisions about how to protect the health of the astronauts and perhaps develop treatments for similar health concerns on Earth.

One of NASA's greatest concerns regarding astronaut health has always been protecting them from the potential side effects of spaceflight. Yet, the NSBRI workshop team felt that one particular issue affecting female astronauts had largely been ignored since women were introduced to the astronaut corps, but it needed to be addressed: pregnancy. Every woman who NASA has selected for the astronaut corps was selected during her childbearing years. Consequently, the issue of pregnancy (planned or unplanned, desired or undesired) affects every one of them and their jobs. Since 1978 when women joined the astronaut corps, the Astronaut Office's policy has been that no pregnant astronauts would be permitted to fly. Further, should a woman not yet assigned to a flight start trying to conceive, the Astronaut Office would remove her from the flight rotation during the time that she is actively attempting to become pregnant.[34]

NASA's concern is twofold. First, the amount of time astronaut crews spend preparing for their missions is significant, usually one full year. If pregnant astronauts were given flight assignments and then a problem develops with the pregnancy or the birth itself prevents her from completing the training or the flight, there is no effective way to replace her with a backup and still retain the same level of proficiency and crew cohesion. In black-and-white terms, this policy is discriminatory. When asked, however, Rhea Seddon admitted that when her husband, Hoot Gibson, was chief of the Astronaut Office, she watched him deal with the challenge of developing the flight schedules, which are done years in advance. Based on her observations, she understood why the policy was the right practice:

> You're assigned to a crew, and you may spend a year planning for that mission that's going to go at some point in the rotation. If you're assigned to a crew that's been all nicely mapped out, and suddenly you become pregnant, there's this quandary. . . . "Now what? Who do we put in there? How close to flight is it? What does that do to the rest of my planning? So I can understand that they [in the Astronaut Office] would like very much for you to let them know if you are trying to get pregnant, may be pregnant, or may have a baby in nine months.[35]

Second, there is no evidence that spaceflight is safe for either the mother or the fetus. Decalcification of bones, muscle deterioration, and radiation represent some of the greatest health risks to astronauts generally. But what those factors could mean for the development of a human fetus is largely unknown. Adding the physical strain that pregnancy puts on the female body led NASA's flight surgeons to decide that the best preventative measure for keeping astronauts healthy during flight—which is their primary function—is to ground any who are pregnant.

If NASA's policy is that no pregnant astronaut will fly because of the potential risk to her and the fetus, then why bother devoting experiment time and space aboard the Shuttle or ISS to questions of reproduction and gestation in space? Was the Astronaut Office looking for a reason to change the policy? Two experiments on reproduction and embryonic development in particular that NASA has publicized both suggested that a developing fetus could experience significant problems. In 1982, the crew of STS-3 flew a collection of houseflies to observe their egg-laying rates. One of the primary researchers, John Baust, a biologist from the University of Houston, indicated that because the chemical reactions during reproduction in houseflies are similar to humans, "Flies provide a model system that may hint at problems man could face in space."[36] The researchers found that the houseflies flown aboard the Space Shuttle *Columbia* laid 57 percent fewer eggs than the control flies left on Earth. During Shannon Lucid's stay on *Mir*, she conducted an experiment studying the development of embryos in fertilized Japanese quail eggs. Those embryos experienced an abnormality rate of 13 percent—a rate four times higher than the rate among the control embryos.[37] NASA's concerns about the health of a fetus, at least early in its development, and the agency's policy against flying pregnant women seem justified.

Ultimately, what the NSBRI committee was trying to accomplish with its evaluation of current NASA policy regarding pregnancy was to flesh out the

impact of being an astronaut on a woman's ability to also have a family. Overall, the astronaut's health was first and foremost; her health was compulsory to her job. But grounding an astronaut when she is pregnant fails to address all the issues. What if she conceived during a mission? Instead of pushing for more research into the effects of spaceflight on pregnancy, the workshop group proposed that NASA provide individual counseling regarding effective birth control. But what is effective birth control in space? The committee noted that "no data exists on the pharmacodynamics of birth control pills in zero gravity and this should be studied to insure efficacy."[38] The committee expressed concern about the lack of research on birth control pills given that the pill also has noncontraceptive benefits, specifically "maintenance of bone density, reduction of the risk of ovarian cysts, ovarian cancer, anemia and benign breast disease," and menstrual control.[39]

When Arnauld Nicogossian asked Seddon to chair the NSBRI panel, he was looking for reasons to justify an all-female flight. Seddon believed that the points the panel made (and ultimately issues that NASA needed to address) were things that the women astronauts stressed were "nonissues" up to that point. Menstruation, on the other hand, has largely remained a nonissue. Initially, NASA's flight surgeons expressed concerns about how menstruation would work in space. Seddon recalled, "We got together with all the flight surgeons, and they said, 'Ok, no one knows, but menstrual flow may go retrograde and come out your tubes and into your abdomen, and you may have an acute abdomen in space, and what would we do?' "[40] Until someone had a period in space, no one could answer those questions. But the first six women insisted that NASA only address the issue if menstruation in space proved to be a problem.

Still, not knowing what would happen, the flight surgeons prepared contingency plans for the first "menstrual cycle in space." NASA could not tell the women to take hormones to suppress their cycles, although that is an option should the women choose that course for themselves. Instead, they packed the personal hygiene kits with up to a hundred tampons or pads (based on the astronaut's preference) in case her flow was particularly heavy and the flight needed to be extended to the maximum two-week duration. It would take a woman with a normal cycle months to use up that supply. But until a woman had her period in space, no one knew what number would be adequate. The women astronauts and the flight surgeons chose to handle it in an ad hoc manner. Seddon said, "We picked a number and the flight surgeons

would say, 'Let's double it just in case.' "[41] Once the flight surgeons understood how menstruation was affected by microgravity, then they could adjust the quantity of tampons or napkins accordingly.

Given that NASA could not legally require the women astronauts to suppress their menstrual cycle with hormones, the flight surgeons along with the women figured out a way to deal with it in space. But birth control and pregnancy, while equally important, were not so pressing. Through the Astronaut Office's policy of not flying pregnant astronauts, the agency as a whole was able to avoid dealing with the subjects. Carolyn Huntoon said in a 2003 interview, "We know a great deal, a tremendous amount about what happens to us when we go into space, and then [there is] a lot of stuff that we don't know that we could know."[42] Pregnancy is one of those areas about which NASA knows very little. If NASA's policy does not permit pregnant astronauts to fly, some might ask why it should matter whether we know more about how pregnancy is affected by microgravity. The potential that NASA's human spaceflight program will participate in future missions to the Moon, Mars, or nearby asteroids or perhaps interplanetary colonization defines the need for that kind of knowledge.

On January 14, 2004, President George W. Bush announced a new space initiative that called for extended human presence on the Moon and human missions to Mars.[43] In April 2010 President Barack Obama announced his plan to transform human spaceflight, working with commercial ventures to develop deep space capacity.[44] For NASA to follow through with such an agenda, the agency must address human sexuality and reproduction among the astronauts. Unless the Astronaut Office openly restricts the missions to a single sex, either men or women, there must be a concerted effort to address the drought of knowledge on human pregnancy, sex, and the effectiveness of birth control in microgravity. Huntoon agreed, "They've tried to start addressing them in a cellular level and with animals. But it's going to have to be addressed in humans."[45]

NASA is a public agency; therefore, its image in the public eye directly affects the overall national willingness to support its activities. Because federal law protects all citizens from participating in medical tests against their wishes and protects the privacy of their medical information, NASA could no more force a female astronaut to fly while pregnant than it could demand any astronaut to provide a urine or blood sample as part of a medical test. Doing so would be illegal, unethical, and possibly a step toward the destruction of

American support for a federally funded space program. But, assuming that space exploration continues with mixed-sex crews and that long-duration missions become more typical, the probability of a human pregnancy in space increases. Unfortunately, NASA would likely be judged on how the agency handles that situation most zealously in the court of public opinion. If the status of the mission precludes bringing the pregnant astronaut back to Earth, NASA might well be held partially culpable for the outcome of the pregnancy. The agency might even be critiqued for not addressing previously the issue of pregnancy with more fervor. At the same time, legally NASA cannot prevent its astronauts from having sexual intercourse with each other in flight—nor should it, given the importance of sexuality as a healthy part of human life, according to Dr. Raymond Noonan, whose research explores human sexuality.[46] Nor can the agency force its astronauts to use birth control. As NASA prepares its long-term agenda for human spaceflight, this is one of the issues that the agency has to face regardless of whether American taxpayers deem it appropriate or not.

While the Astronaut Office reached the decision to restrict pregnant astronauts from flying as a measure to protect the health of its people, the policy itself has protected NASA as a whole from moral and ethical scrutiny. The policy concerning sexual activity served the latter purpose as well. Although unwritten, NASA's policy on sexual intercourse for the astronauts during a mission is "Don't ask. Tell us if you want to." With such a policy, NASA could collect data and information from any astronaut willing to report back on his or her experiences, yet still maintain a position of plausible deniability about sex in space and avoid the ethical backlash. In recent years, the number of rumors and theories about sex between astronauts and between cosmonauts floating through cyberspace seems to have exploded, culminating in the publication of Pierre Kohler's book *La Dernière Mission* (*The Last Mission*) in 2000, which argued that the space agencies in both the United States and Russia sponsored sex experiments in orbit.[47] NASA's policy of not promoting, encouraging, or necessarily even discussing sexual activity in space worked to diffuse much of Kohler's hype.[48]

But with the introduction of women into the astronaut corps, the subsequent marriages between astronauts, and the mixed-sex nature of the crews, NASA, at the very least, has had to think about intercourse in space. For the short-duration missions (as on the Shuttle), the psychological effects of isolation and minimal opportunities for sexual expression tend not to play a factor

in an astronaut's ability to perform his or her job. For that reason alone, NASA has been able to avoid addressing the sex question. As NASA spokesperson Ed Campion said and Rhea Seddon echoed, "We depend and rely on the professionalism and good judgment of our astronauts."[49] But the subject never seemed far away. According to the NASA Standard 3000, the crew quarters design configurations included "quarters for two individuals who want privacy (i.e., married couples)."[50]

NASA has never been in a position to prevent astronauts from having sexual intercourse in space. But with the potential for permanent colonies on the Moon and perhaps missions to Mars, the agency cannot ignore the body of research that deals with the psychological impact of human emotional isolation (inducing the suppression of sexual drives), mostly from studies conducted at overwinter research stations in Antarctica and undersea habitats.[51] However, the social boundaries that seemed to exist around the topic of sex have kept NASA from addressing it wholeheartedly or openly up to now. When asked in 2003 whether sex and pregnancy were issues that NASA could truly address, Carolyn Huntoon replied sadly, "I don't know that it can."[52]

CHAPTER 8

Uninvited Heroics

When NASA selected the first six women astronauts in 1978, no one really knew how having women in the astronaut corps and on the upcoming Space Shuttle flights would work out. As much as the agency prepared for the eventuality of women serving as astronauts, it remained to be determined whether the women would be successful in their jobs, whether they would be accepted into the corps as equals, or whether spaceflight would put a woman's health at risk. News reporters homed in on the particularly historical significance of these first six women and closely followed their paths through training and flight.

For the six female astronaut candidates, this was a dream job. They approached their new jobs with the same drive and dedication that they had given to their careers prior to joining NASA. They almost never considered their sex as significant to what they did, although they were aware that they were unique. In their minds, they were at NASA to do a job—to fly in space and contribute to the overall success of the missions. They expected no special treatment because of their sex. In fact, they demanded it. For Sally Ride in particular, the idea of catching the public's attention just because she was a woman frustrated her.[1] As they have reiterated in interviews and press conferences, the six women all just wanted to be treated like one of the guys. The six women astronauts saw themselves as no more special than their male counterparts, and they should be treated that way.

By taking part in NASA's human spaceflight program, these women and those who have followed in their footsteps have, in fact, done something historically significant. They broke gender barriers and once again proved that women have something to offer professions that before were open only to men. These women have become role models and heroes for a new generation of future astronauts—female astronauts.

Their circumstances, however, have raised an important historical and social question. How do these women reconcile their desire to be "just one of the guys" with their inherent status as role models and heroes by being the first women astronauts? Since leaving NASA, Sally Ride and Kathy Sullivan, in particular, have embraced their hero status and have worked hard to give girls an opportunity to explore the world through science and engineering. They see it as their responsibility to encourage young girls to dare and dream. Historians and feminist theorists often grapple with the concept of how to define difference and sameness between the sexes when discussing sexual equality. In the 1920s that very issue crippled any momentum the women's movement had after the ratification of the 19th Amendment, giving American women the right to vote. Alice Paul, the leader of the National Women's Party, began pushing for an Equal Rights Amendment that would have guaranteed equal access to jobs and equal pay for women. But passing the ERA would have made the laws protecting women's health and safety that women's groups had worked so hard to pass before 1920 unconstitutional. Consequently, almost every other women's organization refused to support the amendment.

The women astronauts exemplify the conflict embedded in that discussion. They demanded equal treatment on the job but then allowed their sexual differences to define their achievements. This chapter discusses how the first women astronauts came to deal with the duality of their own positions and experiences surrounding the sexual integration of NASA's astronaut corps.

NASA's announcement of the names of the astronaut candidates for Group VIII started a media frenzy that turned the six women into the focus of public interest stories around the nation. *Florida Today* published a spread on the women in its magazine *Family Weekly* in March 1978 with a picture of the six women on the issue's cover and an individual photo of each along with the article. The reporters asked each woman what her first reaction was to NASA's invitation to join the astronaut corps and wanted to know how their families were taking the news. Rhea Seddon said about her sister, identified by the authors as a married schoolteacher, "[She] thinks I'm crazy."[2] In thinking about his two daughters—Sally, the astronaut, and Karen, who was just months away from her ordination as a Presbyterian minister—Sally Ride's father said, "One of them ought to find God."[3] The article appeared

four months before the class was scheduled to start training, yet Anna Fisher acknowledged that she was already getting fan mail. "I just got a letter from a little girl saying how happy she was and that she wanted to be an astronaut," Fisher said. She admitted that she was somewhat embarrassed since she did not *feel* like a heroine and did not know how to act in light of her newfound fame.[4] Not long after reporting to NASA and still seven years away from her first flight in 1985, Shannon Lucid turned down the opportunity to be interviewed for a book, claiming that "books are important" and that she had not done anything important enough yet to merit her involvement in such a project. Even after spending 188 days on board the Russian space station *Mir*, setting the American spaceflight duration record (which she held until June 2002 when Carl Walz and Dan Bursch set the new record of 196 days aboard the International Space Station), and serving as NASA's chief scientist, Lucid admitted that she had some extraordinary opportunities, but in her eyes, her accomplishments still did not merit the recognition that a book entails.[5]

A few months into their training, the new astronaut candidates sat down for an interview with a reporter from the Time-Life News Service. The article focused on the African American and female makeup of the group.[6] Frederick Gregory, one of the African American men selected as part of Group VIII, said about the new look of the NASA astronaut corps, "Initially, there is an aura about someone who is an astronaut—like the six million dollar man. That wears off once people realize we get no special treatment."[7] Flight manager Jay Honeycutt agreed with Gregory's analysis of the situation at NASA as it applied to the women: "[They] are given no special treatment and have asked for none."[8] Even though NASA hoped and tried to maintain a normal work environment, the reality was that the selection of women astronauts created a new opportunity to highlight NASA's accomplishments. One news article entitled "The Glamornauts," which referred to the women as "these six NASA lovelies," certainly made the female astronauts out to be more than just "one of the guys" in the eyes of the reader.[9]

Throughout their training and respective missions, each of the women astronauts experienced her own time in the spotlight. Brian Duff in the Office of Public Affairs submitted a memo in March 1983 stating how important it was to emphasize the success of the flights that included the first female and the first African American crew member.[10] As the first American female astronaut, Sally Ride saw more than her share of public attention and scrutiny. She also grew to hate it.

Every day for five days before Ride's launch on June 18, 1983, the *Washington Post* published another part of its story about her entire life: her childhood, her family, her education, the development of her aspirations, and her time at NASA. Her identity as a "First Woman" in history opened her life up for public criticism and also turned her into a presumed "expert" on everything from fashion to politics. In her column for the *Sun* (Boston), Ellen Goodman noted how all First Women share a "special conflict." She wrote, "There is a desire to be accepted as a self-made woman, a person who was and is judged on individual merit. And there is the realization that each carries a load of other women's frustrations and hopes."[11] Supporters across the United States adopted these women as their champions for feminism whether the astronauts identified themselves as feminists or not. In the *Houston Post* article "Feminist Cause Not a Factor, Astronaut Hopeful Says," Judy Resnik argued that she had made it as a female engineer and an astronaut on her own merit. One woman wrote a letter back to the editor stating, "Unfortunately astronaut hopeful Ms. Resnik's 'I pulled myself up by my own bootstraps' syndrome is not unique among successful women. I in no way belittle her accomplishments. But without the 1964 Civil Rights Act and the women's movement, she would not have even had a chance to apply."[12] Whether this woman is right or not is inconsequential. But her comment is indicative of the fact that some Americans were not satisfied with Resnik acknowledging her accomplishments as her own; others needed to couch the successes of the women astronauts as triumphs of the feminist cause. As suggested by Ellen Goodman, the women of NASA's first sexually integrated astronaut class, by their own places in history, found themselves trying to define their own lives while other people shackled them with the title "hero."

Over the last three decades practitioners of women's history and feminist theory have struggled to come to terms with the concept of identity. Philosopher Allison Weir put forth the argument that "any identity is necessarily repressive of difference, of nonidentity, or of connection. Identity is the product of a sacrificial logic."[13] For the women astronauts of Group VIII, arguably society—not the women themselves—defined their identities as heroes and fighters for the feminist cause. In Weir's terms, their public identities developed at the sacrifice of their own personal identities and talents. Throughout their careers at NASA, the six women argued that they were simply "one of the guys" and often took criticism for *not* meeting the public's expectations about what a female astronaut should be. As the only

mother selected for the astronaut corps in 1978, Shannon Lucid sat through continuous questions from reporters about how her children were handling the idea that their mother would go into space.[14] Sally Ride stunned NASA employees when she refused to accept a bouquet of roses and carnations upon the crew's arrival in Houston after the completion of her first flight in space. She saw herself as nothing more than a member of a crew and would not accept accolades not given to everyone involved in the mission.[15] NASA's protocol office arranged for the flowers, certainly thinking that because Ride was a woman, presenting her with flowers was appropriate. But in trying to define herself as just an astronaut and no different from her male crew members, she felt that accepting the bouquet undermined that identity that she and the five other women astronauts were trying to construct for themselves.

By the time these women arrived at JSC for ASCAN training, individually they were already well equipped to deal with the potential sexual discrimination and talk among their coworkers and superiors about being women in a man's world. After all, each worked in traditionally male professions. Sally Ride was a doctoral student in astrophysics at Stanford University. Anna Fisher worked as an emergency room doctor in Los Angeles. Rhea Seddon was completing her surgical residency in Memphis. Kathy Sullivan was finishing her doctorate in marine geology. Judy Resnik worked at Xerox as an electrical engineer. Shannon Lucid was a biochemist for the Oklahoma Medical Research Foundation. Rhea Seddon has said, "I've obviously been a part of a man's world for my entire adult life. And there have been times when that was okay; I was doing what I wanted to do and it was fine. And there were other times when you think, 'Man, this is miserable.'" She further noted, "The thing that bothered me a lot and occasionally still bothers me is that you have to act like a man or you have to look like a man or you have to *be* like a man in order to do your work. I am a 'female' female, and a lot of times you lose credibility by being that way."[16]

As First Women, the six faced expectations that their male counterparts could avoid. NASA, although stridently in support of women in the astronaut corps, needed the women to prove that they were up to the challenge of spaceflight.[17]

Supporters of women's rights may well have viewed the women astronauts as the doorway to greater opportunities for others. By breaking down sexual barriers—both real and assumed—their success as actors in one of the most elite fields in America would suggest that women were capable of all sorts of

jobs previously not open to them. The strategy the six used during their astronaut careers was, and continues to be, to pick one's battles.[18]

Treating questions and concerns as "nonissues" was one of the techniques the women used to avoid special treatment. It was part of how the women downplayed their identities as *women* astronauts within the agency. Seddon recalled one meeting with the engineers designing the Space Shuttle toilet over their concerns about mucus. These engineers ignorantly believed that women secreted more mucus during urination than men, which might clog up the sensitive plumbing. After the six stopped laughing, they assured the male engineers that generally women's urine was the same consistency as men's. However, if they were so concerned, they could take the toilet apart after Sally Ride's flight to confirm that mucus was not an issue.[19]

But what are the consequences of picking one's battles? Does that attitude lead to a mentality of complacency or one that invites unintended discrimination? Might insisting that engineers treat their concerns, such as the mucus case, like nonissues until they become issues result in their future failure to anticipate problems related to women? Whether mucus was an issue or not, it may have been more important to make sure that all necessary steps to accommodate women as equally as men were being made. But as Judy Resnik suggested, these women did not sign up as astronauts to make a statement about women's rights.

Whether the astronauts embraced their public roles or not, women's groups and girls of all ages adopted these women as their heroes. Their uninvited hero status carried with it a socially constructed expectation of their service to other women and the feminist cause. Since leaving NASA, both Sally Ride and Kathy Sullivan have worked hard to encourage girls and young women to study and pursue careers in science and engineering. Ride has participated in a number of special events, including at the U.S. Space Camp, where she sponsored special parent-daughter programs as a way to educate girls about the history of human spaceflight.[20] In 2002, she founded Imaginary Lines, a foundation dedicated to supporting girls' entrances into scientific and technical fields. Kathy Sullivan, former president and CEO of the Center of Science and Industry (COSI), renewed her lifelong commitment to the Girl Scouts of America and science through programs and overnight "Camp-ins" for scout troops at the Columbus, Ohio, center.[21] Their work is commendable. But from Weir's discussion of feminist identity, their efforts at outreach, which are built on their fame and recognition as America's first women astronauts,

seem to conflict with the stance the six women took while at NASA—the position that they did not want any special treatment or recognition *because* they were women.

Further, the culture at NASA—at least from a public relations standpoint—continued to emphasize the specific achievements of women, particularly the achievements of its more publicly recognizable women, the astronauts. Although the last of the six women selected in 1978 to fly, Shannon Lucid is the one with the most extensive spaceflight credentials. She is a veteran of five Shuttle flights, spent six months on *Mir* with her Russian station mates, the "two Yuris"—Yuri Onufriyenko and Yuri Usachev—and she was the first and is the only living female recipient of the Congressional Space Medal of Honor. (In 2004, President George W. Bush bestowed the medal posthumously to the *Challenger* and *Columbia* crews, which included four women.) When Lucid returned from *Mir* in 1996, she became NASA's public relations gold mine.

Even before she broke the record, she was top news for NASA. Lucid's scheduled return to Earth aboard STS-79 (*Atlantis*) got pushed back from August to September 26, 1996, because the flight management team was forced to delay *Atlantis*'s July 31 launch. But NASA started receiving interview requests for Lucid from national and international news shows in the middle of July. In a presentation called "The Shannon Lucid Story: One of the Top 10 Stories of 1996 and Beyond," NASA Public Affairs Office compiled a plan of "maximum exposure with minimum time from [Lucid's] schedule," emphasizing the "biggest bang for the buck." Over 140 interview requests spanned the gamut from local affiliates and newspapers, such as KOTV out of Tulsa, Oklahoma, and the *Houston Chronicle*, to national programming, including CNN International, CBS's *60 Minutes*, and three major networks' national shows.[22] *NBC News with Tom Brokaw* anticipated that Lucid's story would be newsworthy well before she set the new duration record. NBC actually sent its request to interview her upon her return at the family home on March 28, only six days after the launch of Space Shuttle *Atlantis* (STS-76) that carried her to *Mir*.[23] Lucid recalled that for six months after her return, the public appearances and interviews were regular events.[24]

The attention that Lucid's record attracted does not appear to be simply an acknowledgement of the new record. After all, when the new record holders Carl Walz and Dan Bursch returned to Earth in 2002, the press hardly noticed. As evidence, a quick search of the *Newspaper Abstracts* database pulled up only twenty-two articles about Walz and Bursch. An identical

search for Shannon Lucid returned 150 articles. Arguably, what attracted the public to Lucid's experience and made her one of the "top ten stories of 1996 and beyond" was the fact that she was female. According to a 1998 *Washington Post* article, the fact that she was 53 years old also made her a role model for members of the American Association of Retired Persons.[25]

Lucid acknowledges that she was discriminated against because of her sex. But as a mother to a son and two daughters, she has also been critical of any effort to separate out the sexes for any reason. As a senior in high school, she was devastated to learn of her second place finish at the 1960 National Science Fair. It was not exactly the second place finish that stung; it was the fact that she finished second in the *girl's* division. In her mind, the separate divisions suggested that she was not good enough to be judged with the boys. As a mother, she has tried to educate her daughters about the struggles she faced being a woman in the man's world of science. She has also watched her son struggle with the reality that he was overlooked for myriad college scholarships because of what he was: "a plain old white male."[26] Because of these experiences, she refuses to participate in programs that promote science and engineering for just girls or for just boys and admits that she would be very upset if NASA were to sponsor such an event. She acknowledges, however, that women still struggle at NASA and within the public sphere for acknowledgement of their work in spite of their sex.

The crux of any discussion about NASA's first class of female astronauts as feminist role models and heroes depends on how we interpret the concept of equality, as well as sameness and difference. Using Alison Weir's analytical tools, the first question we should ask about the women astronauts is whether they have created irreconcilable identities for themselves. Can they demand equality and sameness from both NASA and the general public, but then stand on ceremony and use their public roles to promote special attention for girls because they are often seen as different from boys? What critics may not see, however, is how important difference is to the way the first American women astronauts approached their work.

While often grouped collectively as women astronauts, these six women are very different from each other. Seddon insisted on taking cosmetics with her as part of her personal preference kit, while Sullivan could not have cared less about taking makeup on her flights.[27] Some are married with children; others are single. One even gave her life to spaceflight.[28] But as the first women paving the way for those to follow, they recognized how important it

was for them to establish precedents. It is clear by now that receiving no special treatment because of their sex was vital to proving that women could do the job. But together they were careful as well to protect their status as contributing members of a team. Sally Ride was particularly careful to include her five female classmates when making procedural decisions. As Kathy Sullivan described it, Ride's idea was to establish consistency in problem solving between the women so no man could accuse them of whining or complaining.[29] Underlying their identities as one of the guys, the six also recognized and valued being one of the girls.

Unlike most fields of work that women enter, the astronaut corps represents one of the most elite jobs anyone can pursue. For men and women alike, the public status of astronauts rivals that of professional athletes, actors, and entertainers. As a result, their lives are constantly under scrutiny. Even Gen. James Abrahamson, the head of the Space Shuttle program between 1981 and 1984, made some critical statements about the women astronauts choosing to have children while they were still active astronauts instead of waiting until they left the corps.[30] In his mind it seemed reasonable to expect the women to be ever ready and vigilant about flying in space just as the men had been. What he failed to recognize was that the male astronauts, who were also typically selected at an age when they would normally be starting their families and raising small children, could do so without affecting their flight status. Abrahamson did not realize that he was holding the women astronauts to a different standard than their male counterparts. The NSBRI workshop on gender-related issues noted with concern NASA's expectation that the women astronauts put their family lives on hold for the sake of their careers.[31]

Even though it meant shining a bright light on the women astronauts, highlighting their successes mattered. Supporters of feminism *need* female success stories, like the first American women astronauts, as fuel for their cause. As people openly criticized them for projecting conflicting personas—that is, one side that demands equality on the basis of "sameness" and the other that champions programs to overcome difference—Allison Weir's assumptions remain. Any claim to a single identity—be it "astronaut" or "female astronaut" or even "female"—entails the repression of difference.[32] Even as a coherent group, the women astronauts react to criticism and questions differently. Rhea Seddon noted, "You react to those sorts of questions depending on [your] comfort level with yourself and how much you

depend on other people's opinion of you."[33] Kathy Sullivan commented, "My time and energies are best spent living the life I've been given as fully as possible and by my best lights. [It] does surprise me that folks somehow think it's my task or concern to address (much less reconcile) others' viewpoints."[34]

By insisting on an identity as "one of the guys" along with a collective identity as the first female astronauts and their individual personas (which are defined by their own histories and value systems), the six women created for themselves complicated social identities. As a suggestion for dealing with the sacrificial nature of identity, Allison Weir offers the following statement:

> Essential to an individual's capacity to problematize and define her own identity are cognitive and practical capacities for self-knowledge, self-realization, and self-direction, which involve cognitive capacities for learning, for critique, and for organization, and practical capacities for expression, engagement, commitment, and flexibility. The development of self-identity requires the cognitive capacity to reflect on who I am and what matters to me, and to organize diverse identities, and identity-attributes, into some sort of meaningful narrative or constellation. It also requires the practical, existential capacity to discover and define and *commit* [emphasis in original] to what matters to me, to my meaning, while remaining flexible and open to change. It is through these practices of expression and critique that social and linguistic norms change, and are kept open and diverse.[35]

At some level, the way the women astronauts constructed their identities seems hypocritical. Not only did they expect to be treated like one of the guys, but some also championed equal rights and the feminist agenda. Weir would applaud these women for finding a way to merge their identities as one of the "thirty-five new guys" with their identities as women and for their unwavering commitment to those two distinct identities. It could be easy to argue that the women's actions were not hypocritical, but rather this was just narrow thinking on the part of those who judged the women for their dichotomous identities. Instead of pointing fingers at one group or another, we need to realize how complicated the concepts of gender and gender identity remain.

Ultimately, NASA wanted these women to succeed as astronauts and hoped they could attract positive attention to the agency. As for their legacy, Rhea Seddon believes, "We each made our mark in our own separate way. We were just like the guys, and I think we proved we could do [the job]. There's not that question anymore. I think that was the big question for everybody

including us: 'Is this going to work for women?' . . . The answer to that was 'Yes.'" Seddon continued, "We're not this separate but unequal cadre. I think we proved to NASA that we were serious astronauts."[36] Although they demanded no special treatment from NASA because they were women, these six women continued to be the kind of women they chose to be in spite of the job. What the general public expected from these new heroes in space and heroes for women developed more out of the centuries-old debate about differences between the sexes and was less about women as astronauts. As challenges to their ability or competence arose, they chose to tackle the problems occasionally from a feminist standpoint, but more often as professionals. In their own ways, from their own experiences, and sometimes as a united force, they did their jobs the best way they knew how given their own personalities and their own scientific, technological, and medical training. In doing so, they challenged the collective identity that still exists about women at work, about women as feminists, and about women as heroes. When we begin to understand the complications that these first women astronauts faced in trying to create a united genderless identity of astronaut, then the conflict between the "woman astronaut" identity and "feminist hero" can fade.

Epilogue

On November 3, 2007, astronauts Scott Parazynski and Doug Wheelock performed a spacewalk to repair a torn solar array on the International Space Station (ISS). The tear formed when the array was being unfurled after its installation by the crews of STS-120 and Expedition 16.[1] What made STS-120 and Expedition 16 special was that both were commanded by women, Shuttle Commander Pamela Melroy and Station Commander Peggy Whitson. This was a historic first for women. But the tear in the solar panel resulted in some negative press for NASA. Was this the result of poor command? Undoubtedly, no. Working in the vacuum of space is difficult, and failures happen. But 2007 was not a good "news" year for women in NASA.

Just ten months before, on February 5, 2007, police at the Orlando International Airport in Florida arrested astronaut and navy captain Lisa Nowak on charges of attempted kidnapping and battery of Colleen Shipman, a woman whom Nowak perceived as a rival for the affections of Nowak's fellow astronaut William Oefelein.[2] It was arguably the lowest point for NASA since the disintegration of the Space Shuttle *Columbia* over the skies of Texas on February 1, 2003. The problems faced by ISS in November 2007 were hardly the fault of the women in command, nor was the backlash specifically targeted at them. But combined with the Nowak incident, it led some to question whether NASA and America's space endeavors were suffering because of the presence of women in the astronaut corps.

This project began based on the assumption that NASA felt pressure to integrate women into the astronaut corps, particularly after Congress passed the Equal Employment Opportunity Act in 1972. As the story of the FLATs has been more widely publicized, it seemed on the surface that perhaps NASA had cultivated a negative attitude about women astronauts since the 1960s. Since it took until 1978 before NASA selected its first women astronauts, fifteen years after the Soviet Union launched its first female cos-

monaut, the basic evidence suggested even more that NASA only opened its doors to women astronauts begrudgingly. The burning question was what political and social factors made it possible for women to become astronauts.

As it turned out, NASA did not discriminate against women in the astronaut corps outright. What the historical record ultimately illustrates is that Cold War politics and the 1961 presidential directive to go to the Moon undermined the agency's freedom to develop the space program and human spaceflight. Those circumstances left the women tested by Randy Lovelace wishing and politicking unsuccessfully for a chance to fly in the 1960s. But as an agency, particularly under the leadership of Administrators James Webb (1960–68) and James Fletcher (1971–77), NASA committed itself to equality in its hiring practices and promoting diversity. Granted, snapshots of the astronaut corps and Mission Control in the 1960s and early 1970s still appeared white and male. But those pictures reflected the face of college graduates in the sciences and engineering at the time, not discrimination on NASA's part.

This study never intended to validate NASA's equal opportunity and diversity records, however. The story represents more than just a case study of top-down organizational efforts to integrate women into its workforce or a prosopography of the bottom-up fight by six women who were the "entering wedge" into one of the most elite professions.[3] By looking at changes in educational patterns for women beginning in the 1960s, the policies that enabled women to enter scientific and technical professions (specifically the astronaut corps), and the social and logistical adaptations that made it possible for the six women of Group VIII to become astronauts, we get insight into the complexity of equal rights for women (or for any minority) in the workplace.

The legacy of the six Group VIII women astronauts was that they were very good at what they did, as good as their male counterparts. As astronaut Rhea Seddon said, "We proved we could do [the job]. There's not that question anymore."[4] But Seddon's interpretation is only partly accurate. They showed that women could do the job of mission specialist. What remained to be seen—at least regarding the Space Shuttle—was whether a woman could do the job of Shuttle pilot and Shuttle commander.

In 1990, NASA announced its latest selection of astronauts, Group XIII. That class contained five women, including U.S. Air Force major Eileen

Collins. The air force opened up pilot training to women in 1976. Collins graduated from undergraduate pilot training in 1979. When the air force opened its test pilot school in 1988, Collins was already serving as a flight instructor. She completed Air Force Test Pilot School at Edwards Air Force Base in California (only the second woman to do so) just before reporting to Johnson Space Center for ASCAN training in June 1990.[5]

Collins became the first female Shuttle pilot with the launch of STS-63 on February 3, 1995. Seven of the thirteen FLATs attended the launch as her guests. What the FLATs had hoped for themselves in the 1960s, Eileen Collins completed in the 1990s. Her "First Woman" achievements continued in July 1999 when she became the first female Shuttle commander aboard STS-93. She also commanded STS-114, the "return-to-flight" mission in July 2005 following the *Columbia* disaster. Since Collins's selection, only two other women have served as Shuttle pilots (Pamela Melroy and Susan Still-Kilrain), and only one woman continued on to become a Shuttle commander (Melroy).[6]

From a technological standpoint, selecting a woman as a pilot astronaut meant making sure that she could reach and manipulate the controls on the flight deck in order to fly the Shuttle. But those were issues that the human factors engineers resolved when they were designing the orbiter in the early 1970s. So really the only "challenge" Eileen Collins faced was proving that she—and other women to follow her—*could* fly the most expensive glider on the planet and command its crew. As one of the most recognizable Shuttle-era astronauts, most Americans would agree that Collins could fly.

In World War II, when women served as pilots to aid in the war effort, many Americans questioned if women could do the job. Historian Deborah Douglas argued in her book *American Women and Flight since 1940* that World War II served as a demarcation point in how society viewed women pilots. According to Douglas, during World War II American society was asking "Can women fly?" She identified the years following the war as the period when society asked "Should women fly?"[7] While the first six female mission specialists and then the first female pilot all proved they could do the job, just as Rhea Seddon argued, their successes on the job did not necessarily convince the American public that women should be astronauts. Each time Carolyn Huntoon went to bat to defend the first six, it showed that even the NASA engineers who witnessed all of the successes and skills the women

astronauts brought to the table second-guessed them. It suggests that the question was not "Are they qualified?" or "Can they do the job?" but rather "Should they be here?"

When Orlando police arrested astronaut Lisa Nowak, news stories and editorials asking what went wrong with this female astronaut littered the newspapers and magazines. People criticized NASA for failing to detect what they interpreted to be a major psychological flaw in Nowak. Articles referred to her as the "astro-nut."[8] Arguably Nowak was suffering emotionally for her to make the poor decision to drive over 950 miles from Houston, Texas, to Orlando, Florida, to confront Shipman. But what does an incident like this mean for women as astronauts and NASA?

Within days of Nowak's arrest, NASA announced its intentions to evaluate its psychological screening practices for applicants and mental health care for the astronaut corps.[9] Its policy up to then included intensive psychological screening during the selection process, as well as psychological evaluations for astronauts selected to serve on the International Space Station six months and one month prior to their launch, then several times in the month after their return. But Shuttle crews receive no additional evaluation or counseling after they join the astronaut corps. Having already put Nowak (and Oefelein) on administrative leave, all that NASA could do to address what many Americans saw as a problem within the organization—the failure to catch Nowak's instability—was examine its policies and procedures for addressing the mental health of its astronauts.

Unfortunately, NASA and the astronauts struggle most with these issues. Astronauts want to fly in space. Since NASA flight surgeons grounded Mercury Seven astronaut Deke Slayton in 1962 for an irregular heartbeat, there lingers a fear among the astronauts that acknowledging a potential health problem could undermine their careers.[10] Admitting to an emotional problem practically guaranteed that an astronaut would never fly. Further, as Carolyn Huntoon noted about the psychological testing for the Group VIII selection, "There are no psychological tests for 'screening in' people; we have lots of 'screen out' tests."[11] Perhaps Lisa Nowak slipped through the cracks. Perhaps there were signs that she was mentally unfit for the challenges and stresses of being an astronaut that NASA missed during her interviews. But, perhaps there was nothing to catch!

Two days after Orlando police arrested Nowak, Dr. Jon Clark, a former NASA flight surgeon who knew Nowak and her husband (from whom she

had separated in the weeks prior to the incident), spoke about Nowak, but also about women astronauts generally: "They make more sacrifices than the 'Right Stuff' guys. They have to balance two careers—to be a mom and wife and an astronaut. You don't come home at night, like most of the male astronauts, and have everything ready for you."[12] As with all career women with families, their lives at home demand as much energy and time as their jobs. Adding to that the public fascination with and expectations of being an astronaut, specifically a woman astronaut, understandably the pressures are enormous. Nowak's fall from grace begins to make sense.

In the long run, Nowak's actions and the November 2009 trial during which she pleaded guilty to third-degree felony burglary and misdemeanor battery will not have a lasting negative impact on the image of NASA, women astronauts, or their ability to do their jobs as well as men. Americans seem to understand that her case, while mostly just sad, is irrelevant to the larger historical questions about women in the workplace. Nevertheless, the comments made by journalists as well as the general public (specifically, "astronut") still resonate. Why do we continue to judge contributions and accomplishments of any group of women by the failures of one?

As an agency, NASA worked hard to integrate women into the most public portion of its workforce. In the process, it treaded carefully around taboos, such as sex and pregnancy, and the real issue of true equality for women since they first entered the astronaut corps. In the intervening years, NASA's engineers and flight surgeons tackled complicated designs and engineering problems, such as the space toilet and female urine collection devices, which also required sensitivity. Advocates such as Carolyn Huntoon helped smooth the process of integration for women, and NASA's culture has grown more accepting of its female astronauts' ability to do their jobs well. Rhea Seddon observed, "When I left NASA in 1996–97, it was a very, very different place. When I came [to Houston] in 1978, I'd go to meetings and I'd be the only woman in the room. When I left, there were women in all levels being given all kinds of opportunities. If you were good at what you did, you were going to go far."[13] NASA's integration of women into the astronaut corps largely is complete. Consequently, it is an unfortunate observation that Carolyn Huntoon made about NASA's ability to deal with the most intimidating social questions of the day, the ones that deal with sex: "There's always criticism that it's not the right time, and we're not the right investigator."[14]

Given the challenges of putting a human into space, then adding the

struggles of sexually integrating its most public workforce, NASA's introduction of women to the astronaut corps represents one of the success stories. Not everyone at NASA wanted the female astronauts to succeed, and women are nowhere near reaching parity with the men in the astronaut corps. But the women have largely become "one of the guys." When asked what she thought NASA's greatest success was concerning the sexual integration of the astronaut corps, Carolyn Huntoon said, "We finally got to the point that we had hoped to get to and that was when the crew was named, the only way you would know somebody was a female was if you saw a crew picture and it was 'Oh, yeah. There's a woman on board.' And it didn't start out that way. It started out with 'four guys and Sally Ride.' "[15]

For Sally Ride, a self-proclaimed feminist, being one of the guys was a priority. For Rhea Seddon, giving up "being a girl" was not an option. Seddon said, "Someone asked me in an interview recently, 'What was your proudest achievement at NASA?' I'm sure she wanted me to answer about an experiment or data that we brought back or lives saved or money saved. But my proudest achievement was that I had a life. I was able to be a female astronaut in a male world, yet continue to be female, and continue to do the things I wanted to do as a female." Seddon flew on three Shuttle missions, including both Spacelab Life Sciences flights, got married, and has raised three children with her astronaut husband, Robert "Hoot" Gibson. She continued, "The six women that came in [to the astronaut corps in 1978] were all different, and I sort of chalked that up to the fact that [NASA] didn't know what they wanted. So they picked a variety to see who was going to be successful. I think we all were and that taught them something. But I was able to accomplish the things that I wanted both at NASA and outside. And I think that says something about being able to do something like that as a female."[16]

As a study in women's history—embedded in labor history, wrapped up in the history of technology—this work serves as an example of how women's history is evolving. Initially women's historians shouldered the task of integrating women into the grand narrative. They showed that women were active contributors, not just passive victims. Phase Two investigated how women made themselves heard. It exposed their strategies and tactics and showed how the women we learned about—thanks to the Phase One historians—got there. We have reached Phase Three: trying to understand why we still struggle to see men and women as equal. Even more relevant, why do we insist on judging women as "other" and their contributions as valuable only

as they compare to the contributions of men? The integration of women into NASA's astronaut corps encompasses discussions of how politics and technology create physical barriers to seeing women as equals. But more importantly, it highlights how cultural ideas about sex and gender, even against the strongest efforts to quash them, survive and continue to muddy the waters. When we bring awareness to the debilitating power of gender biases, then the full integration of women into the workplace and in society will move forward.

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Notes

Introduction

1. Rhea Seddon, telephone interview with author, 21 Apr. 2004.

2. Seddon remembers that *Time* magazine listed Paul's birth on its "Milestones" page and identified him as the first "astrotot." Seddon interview, 21 Apr. 2004.

3. Group VIII, which was made up of fifteen pilots and twenty mission specialists, was selected from over eight thousand applicants. National Aeronautics and Space Administration, "Space Shuttle Astronauts Press Conference," transcript, 16 Jan. 1978, 4, Women in Space, 1978–90 file, NASA HQ.

4. Lois Rita Helmbold and Ann Schofield summarize the historiographical corpus on segregated workspaces in their essay "Women's Labor History, 1790–1945," *Reviews in American History* 17, no. 4 (Dec. 1989): 501–18. To identify the chronological and class-based themes in women's labor history, they draw on works such as Alice Kessler-Harris, *Out to Work: A History of Wage-Earning Women in the United States* (New York: Oxford University Press, 1982); Ruth Milkman, *Gender at Work: The Dynamics of Job Segregation by Sex during World War II* (Urbana: University of Illinois Press, 1987); Kathy Peiss, *Cheap Amusements: Working Women and Leisure in Turn-of-the-Century New York* (Philadelphia: Temple University Press, 1986); William Chafe, *The American Woman: Her Changing Social, Economic and Political Roles, 1920–1970* (New York: Oxford University Press, 1972); Susan Hartmann, *The Home Front and Beyond: American Women in the 1940s* (Boston: Twayne, 1982); and Louise Tilly and Joan W. Scott, *Women, Work and Family* (New York: Methuen, 1978).

5. The disciplines of industrial engineering and ergonomics exist to meet the demands for increased productivity from machinery and employees.

6. Historians delineate between the first and second women's movements in the following way. The period between 1848, when Elizabeth Cady Stanton issued the Seneca Falls Declaration calling for women's right to vote, and 1920, when the 19th Amendment was finally passed, marks the first women's movement. The second women's movement grew active in the late 1960s as an offshoot of the civil rights movement, which failed to promote women's rights alongside rights for African American men.

7. In the last decade, a handful of writers and even fewer scholars started recording the experiences of the first American women to participate in the astronaut

medical testing during the early 1960s. See Stephanie Nolen, *Promised the Moon: The Untold Story of the First Women in the Space Race* (New York: Four Walls Eight Windows Press, 2003); Pamela Freni, *Space for Women: A History of Women with the Right Stuff* (Santa Ana, CA: Seven Locks Press, 2002); Martha Ackmann, *The Mercury 13: The True Story of Thirteen Women and the Dream of Space Flight* (New York: Random House, 2003); and Margaret A. Weitekamp, *Right Stuff, Wrong Sex: America's First Women in Space Program* (Baltimore: Johns Hopkins University Press, 2004). Leslie Haynsworth and David Toomey's book *Amelia Earhart's Daughters: The Wild and Glorious Story of American Women Aviators from World War II to the Dawn of the Space Age* (New York: William Morrow, 1998) attempts to span the gap between the early women pilots and the story of Eileen Collins, the first female Shuttle pilot and commander. Only two books have discussed the women astronauts who joined NASA in 1978 and those who followed. See Laura S. Woodmansee, *Women Astronauts* (Burlington, ON: Apogee Books, 2002); and Bettyann Holtzmann Kevles, *Almost Heaven: Women on the Frontiers of Space* (New York: Basic Books, 2003).

8. Over the past several decades, much of the work in women's labor history has revolved around working-class women, often in industrial and service-related jobs. See Kessler-Harris, *Out to Work*; Milkman, *Gender at Work*; and Peiss, *Cheap Amusements*. But also see Sherna Berger Gluck, *Rosie the Riveter Revisited: Women, the War, and Social Change* (New York: Penguin Books, 1987); Arwen P. Mohun, *Steam Laundries: Gender, Technology and Work in the United States and Great Britain, 1880–1940* (Baltimore: Johns Hopkins University Press, 1999); Wendy Gamber, *The Female Economy: The Millinery and Dressmaking Trades, 1860–1930* (Urbana: University of Illinois Press, 1997); Dorothy Sue Cobble, *Dishing It Out: Waitresses and Their Unions in the Twentieth Century* (Urbana: University of Illinois Press, 1991); Lynn Y. Weiner, *From Working Girl to Working Mother: The Female Labor Force in the United States, 1820–1980* (Chapel Hill: University of North Carolina Press, 1985); and Sarah Eisenstein, *Give Us Bread But Give Us Roses: Working Women's Consciousness in the United States, 1890 to the First World War* (London: Routledge and Kegan Paul, 1983).

9. Those women who were eventually selected for the astronaut corps all had advanced degrees. There is a small niche in the body of works on women's labor history in the United States that focuses on the achievements of women in the professions. Many of them are histories of women in the sciences; even fewer scholarly monographs exist on the history of women in engineering. The best well-known books in this niche are Margaret Rossiter's *Women Scientists in America: Struggles and Strategies to 1940* (Baltimore: Johns Hopkins University Press, 1982) and *Women Scientists in America: Before Affirmative Action, 1940–1972* (Baltimore: Johns Hopkins University Press, 1995). Others include Pnina Abir-Am and Dorinda Outram, eds., *Uneasy Careers and Intimate Lives* (New Brunswick, NJ: Rutgers University Press, 1989); Helena M. Pycior, Nancy G. Slack, and Pnina Abir-Am, eds., *Creative Couples in the Sciences* (New Brunswick, NJ: Rutgers University Press, 1996); Kathleen Broome Williams, *Improbable Warriors: Women Scientists and the U.S. Navy in World War II* (Annapolis, MD: Naval Institute Press, 2001); Margaret A. M.

Murray, *Women Becoming Mathematicians: Creating a Professional Identity in Post–World War II America* (Cambridge, MA: MIT Press, 2000); Anne Witz, *Professions and Patriarchy* (New York: Routledge, 1999); Arleen Marsha Tuchman, *Science Has No Sex: The Life of Marie Zakrzewska, M.D.* (Chapel Hill: University of North Carolina Press, 2006); Ellen Singer More, *Restoring the Balance: Women Physicians and the Profession of Medicine, 1850–1995* (Cambridge, MA: Harvard University Press, 1999); Martha Moore Trescott, *New Images, New Paths: A History of Women in Engineering in the United States 1850–1980* (Dallas: T&L Enterprises, 1996); Judith McIlwee and Gregg Robinson, *Women in Engineering: Gender, Power, and Workplace Culture* (Albany: State University of New York Press, 1992); Susan A. Ambrose, *Journeys of Women in Science and Engineering: No Universal Constants* (Philadelphia: Temple University Press, 1997); and Annie Canal, Ruth Oldenziel, and Karen Zachmann, eds., *Crossing Boundaries, Building Bridges: Comparing the History of Women Engineers, 1870s–1990s* (New York: Routledge, 2003).

10. Elaine Tyler May, *Homeward Bound: American Families in the Cold War Era* (New York: Basic Books, 1988), 38, 52.

11. Michael B. Katz, Mark J. Stern, and Jamie J. Fader, "Women and the Paradox of Economic Inequality in the Twentieth-Century," *Journal of Social History* 39, no. 1 (Fall 2005): 65.

CHAPTER 1: Beyond Rosie the Riveter

1. The song "Rosie the Riveter," which was played on the radio during the war, highlighted her job in the defense industry as a patriotic duty. In her book *Out to Work*, Alice Kessler-Harris includes some of the lyrics to the song. "Rosie's got a boyfriend, Charlie; / Charlie, he's a marine / Rosie is protecting Charlie / Working overtime on the riveting machine." See Kessler-Harris, *Out to Work: A History of Wage-Earning Women in the United States* (New York: Oxford University Press, 1982), 276. Also see Deborah G. Douglas, *American Women and Flight since 1940* (Lexington: University Press of Kentucky, 2004), 40.

2. In Deborah Douglas's updated and revised work *American Women and Flight*, World War II serves as a demarcation point in how society viewed women pilots. Douglas divided the book into two sections reflecting those social changes: Part I is titled "Can Women Fly?" and Part II is "Should Women Fly?" See Douglas, *American Women and Flight*, 10.

3. Ibid., 43–53, 67, 70–78, 88–90.

4. Ibid., 109.

5. Ibid., 118–19.

6. Ibid., 120.

7. Joseph Corn, *The Winged Gospel: America's Romance with Aviation, 1900–1950* (New York: Oxford University Press, 1983), 76.

8. Ibid., 75.

9. Helen Richey served as a commercial airline pilot in the mid-1930s. But forty

years elapsed without another woman working for an American airline. See Douglas, *American Women and Flight*, 176.

10. Leslie Haynsworth and David Toomey, *Amelia Earhart's Daughters: The Wild and Glorious Story of American Women Aviators from World War II to the Dawn of the Space Age* (New York: Perennial, 2000), 158.

11. Ibid., 158–59.

12. Ibid., 165–66.

13. Douglas, *American Women and Flight*, 168.

14. Linda Bird Francke, *Ground Zero: The Gender Wars in the Military* (New York: Simon & Schuster, 1997), 26.

15. Schroeder served as an instructor for the Department of Engine and Technician Training at Sheppard Air Force Base, while Commander Biadosz worked for NATO's Advisory Group for Aerospace Research and Development. See Douglas, *American Women and Flight*, 135.

16. Ibid., 136.

17. Cynthia Enloe, "The Politics of Constructing the American Woman Soldier as a Professionalized 'First Class Citizen': Some Lessons from the Gulf War," *Minerva* 10, no. 1 (31 Mar. 1992): 14. www.proquest.com (accessed 11 Jan. 2001).

18. Marilyn A. Gordon and Mary Jo Ludvigson, "A Constitutional Analysis of the Combat Exclusion for Air Force Women," *Minerva* 9, no. 2 (Summer 1991).

19. Francke, *Ground Zero*, 26.

20. Ibid., 26.

21. Douglas, *American Women and Flight*, 168.

22. Enloe, "American Woman Soldier."

23. Francke, *Ground Zero*, 30.

24. Douglas, *American Women and Flight*, 187. See also the Women in Aviation website, www.womeninaviation.com/sally.html (accessed 20 July 2009).

25. Rachel N. Weber, "Manufacturing Gender in Commercial and Military Cockpit Design," *Science, Technology, & Human Values* 22, no. 2 (Spring 1997): 241.

26. Ibid., 238–39.

27. Ibid., 238.

28. Ibid., 245.

29. Celeste M. Hollands, Flaura K. Winston, Perry W. Stafford, and Stephen J. Shochat, "Severe Head Injury Caused by Airbag Deployment," *Journal of Trauma-Injury Infection & Critical Care* 41, no. 5 (Nov. 1996): 920–22.

30. See J. Reppy's quote in Weber, "Manufacturing Gender," 241.

31. Douglas, *American Women and Flight*, 188–89.

32. "Astronaut Bio: Eileen Collins 5/06," www.jsc.nasa.gov/Bios/htmlbios/collins.html (accessed 20 July 2009); Douglas, *American Women and Flight*, 190.

33. "Navy Public Affairs Library—Women in the Navy: History," www.chinfo.navy.mil/navpalib/people/women/winhist.html (accessed 21 June 2004).

34. Between 1974 and 1988, women had only entered the USAF test pilot school

as flight engineers. In July 1988, Capt. Jacqueline S. "Jackie" Parker became the first woman to graduate from the U.S. Air Force Test Pilot School. www.women inaviation.com/jackie.html (accessed 12 Jan. 2011).

35. Joseph D. Atkinson, Jr., and Jay M. Shafritz, *The Real Stuff: A History of NASA's Astronaut Recruitment Program* (New York: Preager, 1985), 54. Chap. 3 provides further details about recruitment prerequisites for the astronaut classes through the selection of Group VIII as an explanation for the lack of women astronauts into the 1970s.

36. Margaret Rossiter, *Women Scientists in America: Before Affirmative Action, 1940–1972* (Baltimore: Johns Hopkins University Press, 1995), xv.

37. The Soviet launch of *Sputnik* in 1957 focused the nation's attention on science education for all children, but it seems not to have influenced how society perceived women who chose science and engineering as *careers*.

38. The number of women scientists on the National Roster only rose from 4% in 1941 to 4.1% in 1945. See Rossiter, *WSIA: Before Affirmative Action*, 24.

39. Natalie McIntire has recorded the best history to date on the Curtiss-Wright Cadettes from World War II in her 1993 master's thesis, *Curtiss-Wright Cadettes: A Case Study of the Effect of the World War II Labor Shortage on Women in Engineering*. These women, hired by the Curtiss-Wright Aircraft Company, first enrolled in about a year's worth of engineering and drafting courses at one of the seven universities participating in the program, then went to work as replacements for the men who left for the war. McIntire learned from some of the surviving Cadettes that they knew that their jobs would end when the war ended and the men returned to work. Of all the women who participated, very few stayed on at Curtiss-Wright or returned to school to earn a degree in engineering. See Natalie McIntire, *Curtiss-Wright Cadettes: A Case Study of the Effect of the World War II Labor Shortage on Women in Engineering* (master's thesis, University of Minnesota, 1993).

40. Douglas, *American Women and Flight*, 39–40.

41. Rossiter, *WSIA: Before Affirmative Action*, 6–7.

42. Betty M. Vetter, "Changing Patterns of Recruitment and Employment," in *Women in Scientific and Engineering Professions*, ed. Violet B. Haas and Carolyn C. Perrucci (Ann Arbor: University of Michigan Press, 1992), 59–60.

43. Susan M. Hartmann, "Women's Employment and the Domestic Ideal in the Early Cold War Years," in *Not June Cleaver: Women and Gender in Postwar America, 1945–1960*, ed. Joanne Meyerowitz (Philadelphia: Temple University Press, 1994), 86; Rossiter, *WSIA: Before Affirmative Action*, 27.

44. Rossiter, *WSIA: Before Affirmative Action*, xv.

45. Ibid., 27.

46. Margaret Rossiter notes that into the 1960s companies would often hire women into essentially temporary positions that offered no incentive to stay because employers believed that women were bound to leave anyway. Others in industry kept women in their bottom-level positions until they exceeded the "marriage age."

Only then would these women be considered for promotion. See Margaret Rossiter, *Women Scientists in America: Struggles and Strategies to 1940* (Baltimore: Johns Hopkins University Press, 1982), 254–55.

47. Integrated Public Use Microdata Series (IPUMS) project data. Access to the IPUMS census data from 1850 to 1990 is available at www.ipums.umn.edu.

48. Margaret Rossiter discusses in detail the debate over how to overcome the particular shortage of engineers, but scientists as well. Both were viewed as important to winning the Cold War, and it was thought that women might solve the need. See her chap. 2, "'Scientific Womanpower' Ambivalent Encouragement," *WSIA: Before Affirmative Action*, 50–68.

49. U.S. Department of Health, Education, and Welfare, *Annual Report* (Washington, DC: U.S. Government Printing Office, 1957), 11. See also Maris A. Vinovskis, "Missing in Practice? Development and Evaluation at the U.S. Department of Education," in *Evidence Matters: Randomized Trials in Education Research*, ed. Frederick Mosteller and Robert Boruch (Washington, DC: Brookings Institution Press, 2002), 122.

50. National address made by President Dwight D. Eisenhower, 15 Nov. 1957, quoted in James R. Killian, Jr., *Sputnik, Scientists, and Eisenhower: A Memoir of the First Special Assistant to the President for Science and Technology* (Cambridge, MA: MIT Press, 1977), 27.

51. Rossiter identifies that the launch of *Sputnik I* "added a tone of urgency and stridency to the talk of recruiting women scientists." See Rossiter, *WSIA: Before Affirmative Action*, 61. Donna Haraway, who earned a doctorate in biology from Yale in 1972 before transitioning into the history of science as a profession, credits *Sputnik* as much as the women's movement for her decision to study science. Donna Haraway, "Class, Race, Sex, Scientific Objects of Knowledge: A Socialist-Feminist Perspective on the Social Construction of Productive Nature and Some Political Consequences," in Haas and Perrucci, eds. *Women in Scientific and Engineering Professions*, 212–13. Author's interviews with M. Rhea Seddon, 11 Feb. 2003; Carolyn Huntoon, 6 June 2003.

52. Classified Ads, *New York Times*, 9 Oct. 1961, 66. This separation persisted until 1963 when Congress passed the Equal Pay Act.

53. See Rossiter, *WSIA: Before Affirmative Action*, 101–3.

54. Shannon Lucid, interview with the author, Clear Lake, TX, 29 June 2004.

55. Ibid.

56. Ibid.

57. Rossiter, *WSIA: Before Affirmative Action*, 106.

58. Ibid., 61.

59. M. Rhea Seddon, phone interview with the author, 25 Feb. 2004.

60. See table 5.5, "Sectors Employing Scientists Full-Time, by Sex, 1957–58 and 1970," Rossiter, *WSIA: Before Affirmative Action*, 107.

61. Amy Sue Bix, "From 'Engineeresses' to 'Girl Engineers' to 'Good Engineers':

A History of Women's U.S. Engineering Education," *NWSA Journal* 16, no. 1 (Spring 2004): 36.

62. Ibid., 35.
63. Ibid., 35; Rossiter, *WSIA: Before Affirmative Action*, 366.
64. Rossiter, *WSIA: Before Affirmative Action*, 367–71.
65. Ibid., 370–71.
66. Bix, "History of Women's U.S. Engineering Education," 37.
67. Ibid., 38.
68. Ibid., 44.

CHAPTER 2: Wilma Deering Meets Captain Janeway

1. Comments by Eileen Collins, 45th Anniversary Celebration of NASA, National Air and Space Museum, Washington, D.C., 1 Oct. 2003.
2. Robert C. Dille, ed., *The Collected Works of Buck Rogers in the 25th Century* (Broomall, PA: Chelsea House, 1969), vii.
3. Ibid., xviii.
4. Ibid., xviii.
5. Ibid., xvi.
6. Ibid., 145.
7. Ibid., xviii.
8. Harry Harrison, *Great Balls of Fire! A History of Sex in Science Fiction Illustration* (London, UK: Pierrot, 1977), 13.
9. Justine Larbalestier, *The Battle of the Sexes in Science Fiction* (Middletown, CT: Wesleyan University Press, 2002), 2.
10. Harrison, *Great Balls of Fire!* 8.
11. Ibid., 7.
12. Ibid., 39.
13. Ibid., 32.
14. Ibid., 20.
15. One sociological and historical study of interest here would be to examine how *Buck Rogers in the 25th Century* helped to formulate hatred toward the Japanese after the bombing of Pearl Harbor on December 7, 1941. American tendencies to categorize all Asian people into one group might very well have conditioned *Buck Rogers* readers to transport fictional depictions of twenty-fifth-century Mongols to the 1940s Japanese army.
16. The Wonder Woman Pages: Dr. William Moulton Marston website, www.wonderwoman-online.com/marston.html (accessed 23 July 2009).
17. Wonderland: The Ultimate Lynda Carter Site, www.wonderland-site.com (accessed 23 July 2009); see "Comix."
18. Olive Richard, "Our Women Are Our Future," *Family Circle*, 14 Aug. 1942.
19. Ibid.
20. Robert A. Heinlein, *Starship Troopers* (New York: Ace Books, 1959), 8–9.

21. Ibid., 26.
22. Ibid., 10.
23. Louise Kapp Howe, *Pink Collar Workers: Inside the World of Women's Work* (New York: Avon Books, 1978).
24. Heinlein, *Troopers*, 113.
25. Scott McFarlane, *The Hippie Narrative: A Literary Perspective on the Counterculture* (Jefferson, NC: McFarland & Co., 2007), 92.
26. Robert A. Heinlein, *Stranger in a Strange Land* (New York: Ace Books, 1961).
27. Ibid., 16.
28. Ibid., 18.
29. Ibid., 24.
30. Ibid., 53.
31. Ibid., 57.
32. Ibid., 262.
33. Arthur C. Clarke, *Rendezvous with Rama* (New York: Bantam Books, 1973), 10.
34. Ibid., 49.
35. Ibid., 49.
36. Ibid., 242.
37. Ibid., 125.
38. Ibid., 376.
39. Ursula K. Le Guin, *The Left Hand of Darkness* (New York: Ace Science Fiction Books, 1969, 1976), intro.
40. Ibid., 93–94.
41. These are the dualities of sex that Le Guin identifies. Le Guin, *Left Hand*, 94.
42. In her book *How Sex Changed: A History of Transsexuality in the United States* (Cambridge, MA: Harvard University Press, 2002), Joanne Meyerowitz argues through her examination of the history of transsexuals that sex, even at birth, should be thought of as a more fluid characteristic than the duality of male or female.
43. Ursula K. Le Guin, "The Space Crone," in *The Other Within Us: Feminist Explorations of Women and Aging*, ed. Marilyn Pearsall (Boulder, CO: Westview Press, 1997), 249–52. "The Space Crone" first appeared in the *CoEvolution Quarterly*, Summer 1976.
44. Ibid., 250, 251.
45. Ibid., 251, 252.
46. *Star Trek—The Cage*, Paramount Pictures Corp., 1986, videocassette.
47. Ibid.
48. Ibid.
49. According to a 1993 article in the *Washington Times*, Spelling notes that Uhura still had no official first name but acknowledges that Sulu did not get a first name until the motion picture *Star Trek VI: The Undiscovered Country*, released in 1991. Ian Spelling, "Inside Trek," *Washington Times*, 24 May 1993, D5.
50. Promenade: - Iotia: Deep Space 93 - Unofficial CDN/US Star Trek website

lists Uhura's first name as Nyoto. See http://deepspace93.com/promenade.shtml (accessed 12 Aug. 2009). STARTREK.COM identifies her only as "Lt. Uhura" yet shows Nurse Chapel's first name to be Christine. While the 2009 movie *Star Trek* uses the first name, Nyoto, the official movie website only uses "Uhura" on her dossier. See www.startrekmovie.com (accessed 31 Aug. 2009).

51. Michael Logan, "Endless Voyage: Celebrating Star Trek's 30th Anniversary," *TV Guide*, 24 Aug. 1996, 14.

52. Ibid., 26.

53. Ibid., 26.

54. *Barbarella: Queen of the Galaxy*, Paramount Pictures Corp., 1999, DVD.

55. Ian Spelling, "Sirtis: Strong Women Aren't Just on 'DS9,'" *Washington Times*, 9 Aug. 1993, D5.

56. Ibid., D5.

57. Ian Spelling, "More Time on Screen for Dr. Beverly Crusher," *Washington Times*, 5 Apr. 1993, D5.

58. Ian Spelling, "Lwaxana Spins Off for a Visit to 'DS9,'" *Washington Times*, 3 May 1993, D1.

59. Linda K. Kerber, "Separate Spheres, Female Worlds, Woman's Place: The Rhetoric of Women's History," *Journal of American History* 75, no. 1 (June 1988): 11.

60. Nancy F. Cott, *The Grounding of Modern Feminism* (New Haven: Yale University Press, 1987), 154.

61. Katherine Burdekin, *The End of This Day's Business* (New York: Feminist Press, 1989), back cover.

62. Ibid., 87.

63. Heinlein, *Stranger*, 132.

CHAPTER 3: "The Damn Crazy Things!"

1. These women were Myrtle "K" Cagle, Geraldyn "Jerrie" Cobb, Jan Dietrich, Marion Dietrich, Wally Funk, Sarah Gorelick [Ratley], Jane Hart, Jean Hixson, Rhea Hurrle [Woltman], Irene Leverton, Bernice Steadman, Gene Nora Stumbough [Jesson], and Jerri Sloan [Truhill].

2. Margaret Weitekamp, *Right Stuff, Wrong Sex: America's First Women in Space Program* (Baltimore: Johns Hopkins University Press, 2004), 65.

3. Weitekamp maps out the early beginnings of Lovelace Foundation testing best in chap. 4 of *Right Stuff, Wrong Sex*, 63–90.

4. Ibid., 173.

5. Richard O'Mara, "Negative Space," *Baltimore Sun*, 20 Oct. 1998, 1E; Bettijane Levine, "After 36 Years, She's Still Aiming for the Stars," *Los Angeles Times*, 29 Oct. 1998, E-1.

6. Weitekamp, *Right Stuff, Wrong Sex*, 73.

7. Ibid., 77.

8. Ibid., 95.

9. Cochran's role in the "Women in Space" initiative, as it was known, has a checkered history. In her own autobiography, Cochran gives her readers the impression that her motives for providing funds were altruistic. Unfortunately, historians have repeated her version of the story over and again. Margaret Weitekamp offers the first real look at Cochran's involvement in Lovelace's research program and how her own personal agenda may well have contributed to the ultimate failure of the program.

10. NASA has always had more qualified applicants than it needs. Selection committees rely on a lot of unquantifiable data, such as a person's ability and willingness to work with others, in their final analysis and selection of the astronaut class.

11. Weitekamp, *Right Stuff, Wrong Sex*, 92.

12. Ibid., 94.

13. Ibid., 94.

14. Ibid., 94.

15. "A Mrs. in the Missile?" *Los Angeles Times*, 7 Sept. 1958, 12, History Archives, National Aeronautics and Space Administration, Washington, D.C., hereafter cited as NASA HQ.

16. "Space Researcher Sees Female Solos Possible," *Washington Evening Star*, 31 Oct. 1958, 2N, NASA HQ.

17. Joseph D. Atkinson, Jr., and Jay M. Shafritz, *The Real Stuff: A History of NASA's Astronaut Recruitment Program* (New York: Preager, 1985), 29.

18. David Callahan and Red I. Greenstein, "The Reluctant Racer: Eisenhower and U.S. Space Policy," in *Spaceflight and the Myth of Presidential Leadership*, ed. Roger D. Launius and Howard E. McCurdy (Urbana: University of Illinois Press, 1997), 40.

19. Atkinson and Shafritz, *Real Stuff*, 35, 37.

20. Callahan and Greenstein, "Reluctant Racer," 40.

21. Atkinson and Shafritz, *Real Stuff*, 35.

22. The history archives at NASA Headquarters in Washington, D.C., are filled with such letters.

23. Four of the women, Jan Dietrich, Irene Leverton, B Steadman, and Jerrie Cobb, had more hours than all seven of the Mercury astronauts, but none had any jet aircraft hours. Martha Ackmann, *The Mercury 13: The Untold Story of Thirteen American Women and the Dream of Space Flight* (New York: Random House, 2003), 139.

24. Leslie Haynsworth and David M. Toomey, *Amelia Earhart's Daughters: The Wild and Glorious Story of American Women Aviators from World War II to the Dawn of the Space Age* (New York: HarperCollins, 1998), 160–63.

25. "NASA Refutes Space Girl Story," *New York World Telegram*, 29 Sept. 1960, 30, NASA HQ.

26. According to Atkinson and Shafritz, only 508 military records were screened as possible candidates; 110 made the first cut.

27. Atkinson and Shafritz, *Real Stuff*, 10.

28. Gorelick worked for AT&T as an Electrical Engineer in Kansas City when Randy Lovelace contacted her about participating in the medical testing. At 28 years

old, Gorelick was qualified as a commercial pilot in gliders, multiengine and single-engine seaplanes, and held flight instructor ratings. See Haynsworth and Toomey, *Amelia Earhart's Daughters*, 222.

29. Atkinson and Shafritz, *Real Stuff*, 10.

30. According to Atkinson and Shafritz, of the 720 applications NASA received, the selection committee only certified 490 as eligible candidates. Atkinson and Shafritz, *Real Stuff*, 11.

31. Even though NASA recruited scientists for the Apollo program, feelings remained very strained about putting a non–test pilot into space. They were concerned about the danger involved in such a mission and did not feel comfortable with putting someone inexperienced in such a high-risk situation. NASA ultimately recruited scientists for the Apollo program in response to the recommendation by the Space Science Board of the National Academy of Sciences that NASA take full advantage of the scientific opportunity of travel to the Moon. See Atkinson and Shafritz, *Real Stuff*, 67–68.

32. Ibid., 54.

33. Ibid., 54.

34. When officials at the Manned Spacecraft Center sorted through the applications for the first class of scientist-astronauts, only four women in the group of over four hundred people met the basic requirements. NASA then sent those files to the National Academy of Sciences, who made final recommendations to NASA. Jim Maloney, "4 Being Considered as Spacewomen," *Houston Post*, 11 Feb. 1965, Women as Astronauts file, NASA HQ.

35. Atkinson and Shafritz, *Real Stuff*, 13.

36. The age restriction had been lowered from 35 to 34 as part of the Group III selection in 1963. Atkinson and Shafritz, *Real Stuff*, 11–12.

37. Most notably, Jerrie Cobb and Jane Hart pushed until Capitol Hill agreed to hear their pleas for fairness. For two days in July 1963, the House Committee on Science and Astronautics heard their testimonies alleging sexual discrimination by NASA. Of the remaining women to undergo testing at Albuquerque, it is known that at the time, Gene Nora Stumbough did not support an immediate "Woman in Space" program. See Ackmann, *Mercury 13*, 145, 150, 155.

38. Joanne Meyerowitz, "Beyond the Feminine Mystique: A Reassessment of Postwar Mass Culture, 1946–1958," in *Not June Cleaver: Women and Gender in Postwar America, 1945–1960*, ed. Joanne Meyerowitz (Philadelphia: Temple University Press, 1994), 251.

39. Ibid., 232.

40. Ibid., 233.

41. These terms come directly from the episode "The Man with the Power" of *The Outer Limits* from 1963 to describe an American astronaut volunteering for a new, relatively untested project. The MGM Studio productions of *The Outer Limits* episodes are available as videorecordings.

42. Meyerowitz, "Beyond the Feminine Mystique," 232.

43. Haynsworth and Toomey, *Amelia Earhart's Daughters*, 203.

44. Author Tom Wolfe created perhaps the most vivid description of the iconic astronaut in his 1979 book, *The Right Stuff*. More recently, historian Roger Launius has addressed the astronaut image from an analytical perspective. See Roger Launius, "Heroes in a Vacuum: The Apollo Astronaut as Cultural Icon," *Florida Historical Quarterly* 87, no. 2: 174–209. The article discusses the Apollo astronauts but argues that the image fermented during the Mercury era, during which the FLATs underwent medical testing and petitioned for a chance to participate in the space program.

45. Donald Cox, "Women Astronauts," *Space World* 1, no. 10: 60.

46. "The Craftier Sex Is Cleared for Space," *Los Angeles Times*, 28 Aug. 1960, NASA HQ.

47. Ibid.

48. Ibid.

49. "The Photographer and You: Should There Be Women Astronauts?" *Boston Herald*, 27 Aug. 1962, Women in Space file, NASA HQ.

50. Ibid.

51. Ibid.

52. Ibid.

53. Weitekamp, *Right Stuff, Wrong Sex*, 80–81.

54. Robert C. Toth, "Women Pilots Make Bid for a Chunk of Space," *New York Herald Tribune*, 18 July 1962, NASA HQ.

55. "Lady Fliers Ask to Be Astronauts, Too; Plead for Co-Eds in Space," *Wall Street Journal*, 18 July 1962, 8, NASA HQ.

56. Charlotte Moulton, "It Shouldn't Be a Stag Club," *Washington Daily News*, 18 July 1962, 4, NASA HQ.

57. "Of Sex and Spaceniks: Cochran Briefs Congress," *New York Daily News*, 18 July 1962, NASA HQ.

58. Joan McCullough, "The 13 Who Were Left Behind," *Ms. Magazine*, Sept. 1973, 44.

59. William McPherson, "Glenn Would Yield Space in Space," *Washington Post*, 19 July 1962, 2; "2 Astronauts 'Scrub' Bid of Women Pilots," *Chicago Tribune*, 19 July 1962, 14, NASA HQ.

60. "2 Astronauts 'Scrub' Bid," 14.

61. "Glenn Would Yield," 2.

62. Ibid.

63. Ibid.

64. William McPherson, "Women Fliers Try to Crack Barriers on Space Travel," *Washington Post*, 18 July 1962, 2, NASA HQ.

65. National Aeronautics and Space Administration, *Western Space Age Industries and Engineering Exposition and Conference* (Washington, DC: U.S. Government Printing Office, 1962), 32. National Air and Space Museum Library (hereafter cited as NASM).

66. Ibid., 39.

67. As an agency completely reliant on federal funding to stay alive and competitive, NASA must constantly prove its worth as an organization that can produce scientific and technical results with value to American society. In the 1960s, President Kennedy used NASA for its prestige value. Consequently, technological successes alone were the major factor behind the public support for space. As the political leadership has changed, so has NASA's mission and focus. By the time Nixon entered the White House, the political and public eye had turned away from NASA as a source for international bragging rights, thereby giving the agency's leadership a bit more breathing room. *Spaceflight and the Myth of Presidential Leadership*, edited by Roger Launius and Howard McCurdy, offers a clear outline of how political agendas from Eisenhower through to the Clinton administration changed and affected NASA's strategic plans over time.

68. Robert Gilruth to Jerrie Cobb, 17 Apr. 1962, Women in Space Program file, NASA HQ.

69. Ibid.

70. Jerrie Cobb and Jane Hart confirmed that spaceflight meant inherent risk. Hearings before the Special Subcommittee on the Selection of Astronauts of the Committee on Science and Astronautics, U.S. House of Representatives, Eighty-seventh Congress, 2nd Session, 17 and 18 July 1962 (Washington, DC: U.S. Government Printing Office, 1962), 16, Women/Mercury Astronauts file, NASA HQ.

71. Marie Smith, "Senator's Wife Wants Distaff Elbow Room: Asks Space for Women in Space," *Washington Post*, 14 Mar. 1962, 6, NASA HQ. Albert Parry, a Professor at Colgate University in Hamilton, New York, also noted that in May 1961 Dr. Heinz Kaminski, the chief observer at a Bochum, Germany, observatory, picked up a radio transmission of Russian space-training exercises. The voice of one Soviet trainee was "definitely a woman." Albert Parry, unpublished paper, "Woman's Place in Outer Space," Women in Space, 1975–77 file, NASA HQ.

72. William S. White, "Space Race Is a Serious, Adult Business," *Sunnydale Daily Standard-Mountain View Register Leader*, 7 Mar. 1962, Astronauts Group II file, NASA HQ.

73. Ibid.

74. Drew Pearson, "Women Pilots Angry at Webb," *Washington Post*, 20 June 1963, Jerrie Cobb file, NASA HQ.

75. Ibid. The FLATs' anger toward James Webb unfortunately left some people believing that Webb was solely responsible for excluding women from space. A photo caption from *Parade: The Sunday Newspaper Magazine* in the *Washington Post* identified James Webb as having "turned down another appeal to train lady astronauts." It continued, "He still insists upon veteran jet pilots as astronauts." *Parade*, 24 Mar. 1963, 2, NASA HQ.

76. Louise Sweeney, "Why Valentina and Not Our Gal?" *Berkshire Eagle* (Pittsfield, MA), 21 June 1963, Jerrie Cobb file, NASA HQ.

77. Robert Ruark, "Let the Girls, Bless 'Em, Cut Loose in Space!" *Washington Daily News*, 8 Aug. 1962, 8, NASA HQ.

78. Ibid.

79. Ibid.

80. "Is Woman's Place on the Moon, Maybe?" *Boston Globe*, 27 Apr. 1965, NASA HQ.

81. Ibid.

82. Ibid.

83. Ibid.

84. Irma Reynolds to James Webb, 21 Feb. 1965, Women in Space (II) file, NASA HQ.

85. "Is Woman's Place."

86. Dorothy Roe, "Girls, Space Travel Might Be a Bit Rough," *Orlando Sentinel*, 18 Mar. 1965, NASA HQ.

87. Ibid.

CHAPTER 4: Making Space

1. *America's Next Decades in Space: A Report of the Space Task Group* (Washington, DC: National Aeronautics and Space Administration, 1969), 45.

2. John M. Logsdon, "The Decision to Develop the Space Shuttle," *Space Policy* 2, no. 2 (May 1986): 106.

3. Richard W. Orloff, *Apollo by the Numbers: A Statistical Reference* (Washington, DC: National Aeronautics and Space Administration, 2000), app. 16.

4. The success of biographies, films, anniversary events, and memorabilia from the Apollo era alone can confirm the public drive and support behind NASA's endeavors. A search conducted on April 25, 2004, for items related to Apollo on ebay.com, the leading American auction site on the Internet, found 2,621 items nearly 35 years after the *Apollo 11* landing. See further articles such as Paul Marks, "America Put Everything behind Race to Moon," *Hartford Courant*, 6 July 2003, B5.

5. Discussion of von Braun's vision for an orbiting space station can be found in Michael J. Neufeld's biography, *Von Braun: Dreamer of Space, Engineer of War* (New York: Random House, 2007), and Howard McCurdy's *Space and the American Imagination* (Washington, DC: Smithsonian Institution Press, 1997), 166–67.

6. "A Mrs. in the Missile?" *Los Angeles Times*, 7 Sept. 1958, 12.

7. "Is NASA for Coeds? Women's Place in Outer Space," *Washington Post*, Women in Space file, NASA HQ.

8. Ibid.

9. Ibid.

10. Ibid.

11. "Lady Astronauts? It's a Possibility," *Houston Chronicle*, 8 Oct. 1965, Women in Space file, NASA HQ.

12. Nick Lamberto, "Astronaut Predicts U.S. Space Flights by Women," *Des Moines Register*, 11 July 1964, Neil A. Armstrong (to A-11) biographical file, NASA HQ.

13. Yvette Cardozo, "Glenn Sees Place for Girls in Space," *Miami Herald*, 22 May 1965, Women in Space file, NASA HQ.

14. George Mueller, "The New Future for Manned Spacecraft Developments," *Astronautics and Aeronautics* 7 (Mar. 1969): 29.

15. Al Volker, "Shuttle Open to Astrodames: Space Shuttle Won't Bypass Women, but Will Cut Down Program Costs," *Miami News*, 1 May 1971, 5.

16. Ibid.

17. William H. Chafe, *The Unfinished Journey: America since World War II* (New York: Oxford University Press, 1984), 318.

18. Terry H. Anderson, *The Sixties*, 2nd ed. (New York: Pearson Longman, 2004), 84–85.

19. Anderson's reference to segregation in educational facilities in the North cites a study completed by the Civil Rights Commission. See Anderson, *The Sixties*, 75.

20. Ironically, conservative Southerners in Congress had actually added the term "sex" as a way to kill the bill. See Chafe, *The Unfinished Journey*, 330.

21. Anderson, *The Sixties*, 85.

22. Ibid., 85–86.

23. Ibid., 86.

24. Ibid., 74.

25. James E. Webb, Policy Directive NPD 3713.3, 31 Mar. 1966, Management Directives / Personnel Directives file, Box GR 1006, Johnson Space Center Archives, University of Houston–Clear Lake, Houston, TX (hereafter JSC).

26. James E. Webb, Management Instruction NMI 3713.4, 15 June 1966, Box GR 1006, JSC.

27. President, Executive Order, "Equal Employment Opportunity, Executive Order 11246," *Federal Register* 30, 12319, 12935, 3 CFR, 1964–65 Comp.: 339.

28. Anderson, *The Sixties*, 86.

29. Executive Order 12640 in 1988 established the President's Committee on Employment of People with Disabilities. President, Executive Order "The President's Committee on Employment of People with Disabilities, Executive Order 12640," *Federal Register* 53, 16996, 3 CFR, 1988 Comp.: 640. Congress did not pass the Americans with Disabilities Act, which provided employment discrimination protection for the disabled, until 1990.

30. This became Johnson Space Center in 1973.

31. Robert R. Gilruth, Management Instruction MSCI 3713.4C, 19 Aug. 1969, Box GR 1022, JSC.

32. Robert R. Gilruth, Management Instruction MSCI 3713.4D, 2 Mar. 1970, Box GR 1022, JSC.

33. See MSCI 3713.4D (2 Mar. 1970)–3714.4G (8 Dec. 1972), Box GR 1022, JSC.

34. Joyce Gelb, "Equal Employment Opportunity Policy in the United States," *PS Online*, Jan. 2004, www.apsanet.org/PS (accessed 24 Mar. 2004). Gelb's abstract is available in *PS: Political Science and Politics* 37 (1): 67.

35. Sharon E. Macha, "Without," *Houston Post*, 7 July 1978, 6, NASA HQ.

36. Nancy Grace Roman, interview with Rebecca Wright, NASA Headquarters History Office, 15 Sept. 2000, www.jsc.nasa.gov/history/oral_histories/herstory.htm (accessed 9 Sept. 2010).

37. Nancy G. Roman to Dr. D. W. Canham, Jr., 20 Oct. 1966, Women in Space (II) file, NASA HQ.

38. Nancy G. Roman to Miss Karen Riley, 30 Jan. 1969, Women in Space (II) file, NASA HQ.

39. "Solar System Exploration: People: Nancy Roman." Available at http://solarsystem.nasa.gov/people/profile.cfm?Code=RomanN (accessed 26 Feb. 2010).

40. Carolyn Huntoon, interview with Rebecca Wright, NASA Headquarters History Office, 5 June 2002, www.jsc.nasa.gov/history/oral_histories/admin.htm (accessed 26 Feb. 2010).

41. Carolyn Huntoon, interview with author, Barrington, RI, 6 June 2003.

42. Ibid.

43. Ibid.

44. Will McNutt, "Poppy Helped Astronauts: 26-Year-Old Blonde Works in NASA Control," *Sunday Star* (Washington, DC), 3 May 1970, Section J (Woman's World), Women in Space (II) file, NASA HQ.

45. C. C. Miniclier, "Woman Launches Satellite," *Evening Star* (Washington, DC), 15 Dec. 1970, Woman's World section, B-8.

46. McNutt, "Poppy Helped Astronauts."

47. Miniclier, "Woman Launches Satellite."

48. Huntoon interview, 6 June 2003.

49. Group VI represented the second class of scientist-astronauts, the only astronaut position for which women could have met the qualifications at the time. Although few women in 1967 would have possessed the educational background and experience as well as the desire to be a scientist-astronaut, it was almost impossible for women to qualify as pilot-astronauts given the restrictions on women flying in the military.

50. "Astronauts Wanted; Women, Minorities Are Urged to Apply," *New York Times*, 8 July 1976, 12; "Women Astronauts Sought," *Baltimore Evening Sun*, 17 Mar. 1976, 1. The second article states, "The space agency will soon start looking for a few good men—and for some women, too."

51. Logsdon, "Decision," 104.

52. Only one program was going to get funding. Without the Shuttle, however, the Station would be difficult to build and maintain. Consequently, the choice for NASA was either to accept funding for the Shuttle or not. Ibid., 104.

53. John Ehrlichman, handwritten notes to 26 Dec. 1969 budget meeting, Richard M. Nixon Presidential Papers, NARA, College Park, MD. These papers were shipped to the Richard M. Nixon Presidential Library in Yorba Linda, California, in spring 2010.

54. "Statement by Dr. Fletcher," 3 Jan. 1972, 11, File 87-12, Box 58, George M. Low Papers, Rensselaer Polytechnic Institute archives, Troy, NY, hereafter Low Papers.

55. "Statement by Dr. Fletcher," 3 Jan. 1972, 12, File 87-12, Box 58, Low Papers.

56. Ibid.

57. Historian Roger D. Launius, who has written about Administrator Fletcher's leadership at NASA, stated that Fletcher was "tolerant of other views and would not force his morals, politics, or whatever on others." Launius quoted a colleague of Fletcher's as characterizing him as "practical, sensible, devoid of vanity and willing to talk candidly about any issue, even those which might be embarrassing." See Roger D. Launius, "A Western Mormon in Washington, D.C.: James C. Fletcher, NASA, and the Final Frontier," *Pacific Historical Review* 64, no. 2 (May 1995): 221.

58. Frank Macomber, "With Man on Moon: Can Space Lady Be Far Behind," *San Jose Mercury*, 26 July 1972, 5.

59. Harold Sandler and David L. Winter, *Physiological Responses of Women to Simulated Weightlessness: A Review of the Significant Findings of the First Female Bed-Rest Study* (Washington, DC: National Aeronautics and Space Administration, 1978), 1.

60. Ibid., 2.

61. Ibid., 1.

62. "NASA Doctor Feels Trapped in the Middle of Controversy over Women in Space," *Sun*, 8 Oct. 1973, reprinted by Office of Public Affairs, *Current News*, 9 Oct. 1973, Women in Space file, NASA HQ.

63. Ibid.

64. The National Organization for Women (NOW) made a public attack on NASA's leadership for continuing to launch only men into space in August 1974, a date by which NASA had arguably made it clear that the agency was taking positive steps toward putting women in space. NOW went so far as to place NASA administrator James Fletcher on its list of "FBI (Feminist Bureau of Investigation) Ten Most Wanted Men for Offenses against Women." Judy Flander, "NOW Banks Too Hard on One Zap," *Washington Star-News*, 27 Aug. 1974, C-1, Women in Space file, NASA HQ.

65. "Women Complete Space Tests," *Salem Times*, Jan. 1979, 10–12, Women in Space (II) file, NASA HQ.

66. "There's No Cloud 9 in Space Life," *Plain Dealer*, 22 May 1974, 10–11, Women in Space (II) file, NASA HQ.

67. In a note from George Low to Dr. John Naugle, Low attached a chart showing the decrease in congressional funding for NASA over fiscal years 1973–77. The chart listed the budget for FY 1966 at $11.4 billion, while in FY 1977 funding dropped to $3.676 billion. Had Congress maintained its level budget commitment from January 1972, the 1977 budget should have been at least $4.838 billion. George Low to John Naugle, 14 Apr. 1976, File 87-12, Box 72, Low Papers.

68. Memo, "Today's Issues Survey," 1 Mar. 1971, File 87-12, Box 72, Low Papers.

69. George Low to Assistant Administrator for Public Affairs, "Memorandum: Smithsonian Questionnaire," 29 Aug. 1973, File 87-12, Box 16, Low Papers.

70. George Low to Edgar M. Cortright, 9 June 1971, File 87-12, Box 57, Low Papers.

71. Ibid.

72. George Low to Brian O'Brien, 10 Jan. 1972, File 87-12, Box 17, Low Papers.

73. Mark E. Byrnes, *Politics and Space: Image Making by NASA* (Westport, CT: Praeger, 1994), 38, 78.

74. Ibid., 99, 101.

75. George Low to Manager, Solar and Chemical Power, 12 June 1974, File 87-12, Box 15, Low Papers.

76. George Low to Dr. Carl Sagan, 28 June 1974, File 87-12, Box 15, Low Papers.

77. George Low, Memorandum for the Record, 6 Jan. 1975, File 87-12, Box 15, Low Papers.

78. Ibid.

79. Harvey W. Herring to George M. Low, 8 Jan. 1975, File 87-12, Box 15, Low Papers.

80. Low, Memo, 6 Jan. 1975, Low Papers. ERTS I was first launched in July 1972. Renamed Landsat in 1975, six more satellites were put into orbit, the last being launched on April 15, 1999. See http://rst.gsfc.nasa.gov/Intro/Part2_15.html (accessed 26 Mar. 2010).

81. John E. Naugle to Dr. Homer Newell, 27 June 1975, File 87-12, Box 14, Low Papers.

82. George M. Low, "Memorandum: Astronaut Policy," 25 Mar. 1974, File 87-12, Box 15, Low Papers.

83. "Women Space Specialists at MSFC," Poindexter Reference File, Box 18, JSC.

84. Ibid.

85. George M. Low, "Memorandum for the Record: Meeting with Headquarters Equal Employments Opportunity Advisory Group," 26 June 1974, File 87-12, Box 15, Low Papers; George M. Low, "Memorandum to Center Directors," 11 Apr. 1975, File 87-12, Box 14, Low Papers; George M. Low, "Memorandum: FY 1976 Affirmative Action Plan," 27 May 1975, File 87-12, Box 14, Low Papers; George M. Low, "Memorandum: Additional Funding for Schools with Predominantly Minority Enrollments," 23 Feb. 1976, File 87-12, Box 13, Low Papers.

86. George Low to Kurt H. Debus, Low to Edgar M. Cortright, Low to Hans M. Mark, Low to John F. Clark, Low to Christopher C. Kraft, Low to Bruce T. Lundin, Low to Rocco A. Petrone, 4 Sept. 1973, File 87-12, Box 16, Low Papers.

CHAPTER 5: "The Strange Ones"

1. Donna Miskin, "In the New Astronaut Class," *Washington Star*, 19 Nov. 1978, C-5.

2. Ellison Onizuka, the first Japanese-American astronaut, is often recognized as

well by his Hawaiian ancestry. As for Judy Resnik, she aggressively went about identifying herself simply as an astronaut and neither a "Jewish astronaut" nor a "female astronaut." See Bettyann Holtzman Kevles, *Almost Heaven: The Story of Women in Space* (New York: Basic Books, 2003), 70.

3. Information about the press conference on January 16, 1978, held at 1:00 p.m. in Washington, D.C., comes directly from a transcript of the event. "Space Shuttle Astronauts Press Conference," Women in Space 1978–90 file, NASA HQ.

4. "Space Shuttle Astronauts Press Conference," 16 Jan. 1978, 12, Women in Space 1978–90 file, NASA HQ.

5. The Ad Hoc Subcommittee on the Scientist-Astronaut program from the Apollo era reached the conclusion that to make the best use of the scientist-astronauts, NASA needed to not only encourage but also enable them to continue practicing their chosen fields. For the incoming mission specialists of the Shuttle era, their training schedule would include opportunities to do their own work. "Space Shuttle Astronauts Press Conference," 16 Jan. 1978, 13, Women in Space 1978–90 file, NASA HQ.

6. "Astronauts' Debut," *Today*, 1 Feb. 1978, 1A, Judith A. Resnik biographical file, NASA HQ.

7. Kathryn D. Sullivan, interview with author, 19 Nov. 2002.

8. This is not really a new experience at NASA. Popular culture understandings about the Mercury Seven astronauts, based largely on Tom Wolfe's book *The Right Stuff* and the subsequent film, suggest that the astronauts would often reach an agreement on a particular issue among themselves, then present a united front to management. As a new breed of astronauts, one might assume that the scientist-astronauts of the 1960s took a very similar approach to problem solving and image forming within the astronaut corps as the Mercury Seven. The first women astronauts most certainly did.

9. George M. Low to NASA Center Directors, 18 Sept. 1972, File 87-12, Box 35, Low Papers.

10. George M. Low to Associate Administrator for Space Flight, 15 Dec. 1975, File 87-12, Box 13, Low Papers.

11. "Astronauts Wanted; Women, Minorities Are Urged to Apply," *New York Times*, 8 July 1976, 12, Women in Space, 1977–79 file, NASA HQ.

12. Lyndon B. Johnson Space Center, *Space Shuttle* (Washington, DC: National Aeronautics and Space Administration, 1976), vi.

13. Frank Macomber, "With Man on Moon: Can Space Lady Be Far Behind," *San Jose Mercury*, 26 July 1972, 5.

14. When Chris Kraft asked Huntoon whether she was interested in applying for an astronaut position and then asked her to serve on the selection committee, she had been serving as an assistant in the director's office as part of a mentoring program for NASA's up-and-coming leaders. Carolyn Huntoon, interview with author, Barrington, RI, 6 June 2003; Carolyn Huntoon, interview with Rebecca Wright, Barrington, RI, 5 June 2002. Available at www11.jsc.nasa.gov/history/oral_histories/HuntoonCL/huntooncl.pdf (accessed 18 Aug. 2010).

15. Huntoon interview, 6 June 2003.

16. Ibid.

17. "New Astronauts," *Today* (FL), 6 May 1977, 14A.

18. "Nichelle Nichols . . . Lt. Uhura in 'Star Trek: The Wrath of Khan,'" *Baltimore Afro-American*, 5 June 1982, Nichelle Nichols (Star Trek) file, NASA HQ.

19. Joseph D. Atkinson, Jr., and Jay M. Shafritz, *The Real Stuff: A History of NASA's Astronaut Recruitment Program* (New York: Preager, 1985), 133; "Women Astronauts Chosen for Space Shuttle Crew," *New York Times*, 14 June 1978, 8.

20. John E. Naugle to Associate Administrator for Applications, Acting Assoc. Admin. for Aeronautics and Space Technology, Assoc. Admin. for Space Science, Assoc. Admin. for Tracking and Data Acquisition, Assistant Admin. for Planning and Program Integration, 15 Feb. 1977, Payload Specialists (II) file, NASA HQ.

21. Huntoon interview, 6 June 2003.

22. National Aeronautics and Space Administration, "Space Shuttle" (Washington, DC: U.S. Government Printing Office, 1982), 5.

23. P. J. Weitz to All Astronauts, 12 Sept. 1983, Central Subject Files, E 154 H5 Shuttle Program Files, National Archives and Records Administration—Southwest Region (Fort Worth, TX), hereafter NARA-SW.

24. Author's interviews with M. Rhea Seddon, 12 Feb. 2003.

25. "Amiable strangers" was a label that Collins gave the crew in his book *Carrying the Fire* (New York: Ballantine Books, 1975). James R. Hansen discusses Collins's description more fully in the chapter entitled "Amiable Strangers" in *First Man: The Life of Neil A. Armstrong* (New York: Simon & Schuster, 2005), 335–59.

26. Kathy Sullivan, interview with author, Columbus, OH, 19 Nov. 2002.

27. Naugle to Associate Administrator for Applications, Acting Assoc. Admin. for Aeronautics and Space Technology, Assoc. Admin. for Space Science, Assoc. Admin. for Tracking and Data Acquisition, Assistant Admin. for Planning and Program Integration, 15 Feb. 1977, Payload Specialists (II) file, NASA HQ.

28. Huntoon interview, 6 June 2003.

29. Ibid.

30. Sullivan interview, 19 Nov. 2002.

31. Ibid.

32. Huntoon interview, 6 June 2003.

33. Group VI, selected in September 1967, was the second class of scientist-astronauts and the last class that NASA selected before 1978. The Group VII astronauts transferred to NASA from the U.S. Air Force Manned Orbiting Laboratory program. For a limited discussion of Group VII, see Joseph Atkinson's *The Real Stuff*.

34. Sullivan interview, 19 Nov. 2002.

35. Huntoon interview, 6 June 2003.

36. Mary Lu Abbott, "Space Women: Men Astronauts Take Backseat in NASA's Newest Crew Lineup," *Houston Chronicle*, 1 Feb. 1978, 12–13; James Hoffman and Mathew Tekulsky, "Adventurers in Space: Six Extraordinary Women Look to the Stars and See Their Futures," *Today* (FL), 19 Mar. 1978, Family Weekly, 6–7; Sara Terry,

"New Astronaut Set for Move: Both Fishers Welcome Her Selection by NASA," *Christian Science Monitor*, 17 Apr. 1978, 18.

37. According to a NASA news release, most of the ASCANs had completed water survival training prior to their selection. Only those without the training, which included the six women, traveled to Homestead. "Astronaut Candidates Learn Water Survival Techniques," JSC Release No. 78–32, 24 July 1978, Women in Space file, NASA HQ.

38. "Sextet for Space," *Newsweek*, 14 Aug. 1978, 5; "People," *Time*, 14 Aug. 1978, 79.

39. "Sextet," *Newsweek*, 5.

40. "People," *Time*, 79.

41. Ibid., 79.

42. "Astronaut Candidate Training Program," 1977, Presentation material, Box 33, Shuttle files, JSC. By 1990, documentation for the ASCAN training program specifically listed a legal briefing and a meeting with the speechwriter as part of orientation as well. See "1990 Astronaut Candidate Training Program: Flight Crew Operations Directorate," Apr. 1990, Astronaut Office file—Position memos, NARA-SW.

43. Huntoon interview, 6 June 2003.

44. "Astronaut Candidate Training Program," 1977, Presentation material, Box 33, Shuttle files, JSC.

45. Ibid.

46. Ibid.

47. Ibid.; Crew Training and Procedures Division, "SSV ORNT 1107 Space Shuttle Vehicle Orientation," Box 30, Shuttle files, JSC.

48. Sullivan interview, 11 Nov. 2002; Seddon interview, 12 Feb. 2003.

49. "Astronaut Candidate Training Program," 1977, Presentation material, Box 33, Shuttle files, JSC.

50. Ibid.

51. Donald K. "Deke" Slayton to M. E. Burke, Dryden Flight Research Center, 14 Nov. 1979, Box 019-12, Shuttle files, JSC.

52. Rhea Seddon, Personal communication with author, 22 Oct. 2004.

53. According to data from the U.S. census and the National Science Foundation, compiled by the SWE between 1983 and 1999, the number of women employed as engineers peaked in 1998 at 11.1% (having only climbed from 5.8% in 1983). The number of women completing undergraduate degrees in engineering rose from 146 in 1966 (0.4% of the total number of engineers graduating with a bachelor's degree) to 11,316 (17.9%) in 1996. The largest number of undergraduate degrees awarded to women in that period was 11,404 (15.3%) in 1987. See www.swe.org/SWE/ProgDev/stat/employ_graph.html and www.swe.org/SWE/ProgDev/stat/earnbach_table.html (accessed 20 Aug. 2010). NASA's own statistics published for the fiscal years 1995 and 1996 show women representing 33.1% of its workforce. The raw numbers of women that NASA employed in 1995 and 1996, respectively, were 6,489 and 6,299, up from 4,874 in 1983. While these numbers do not identify the percentage of

women working as engineers or scientists, no NASA center outside of NASA Headquarters employed a higher percentage of women than 39.2% of its workforce (Stennis Space Center, which serves as the primary testing and certification facility for NASA's large propulsion systems). See 1997 NASA Pocket Statistics, available at http://history.nasa.gov/pocketstats/sect D/Women Em.pdf (accessed 20 Aug. 2010).

54. NASA, *Shuttle Fact Sheet*, 1981.

55. Memorandum, George W. S. Abbey to Chief, Astronaut Office, 19 May 1982, Central Subject Files, Crew Training Correspondence, NARA-SW.

56. Huntoon interview, 6 June 2003.

57. Ibid.

58. Beverly Motz, wife of a faculty member at the USAF Academy in 1976 when female cadets were first admitted, recalls her observations about providing sports bras for the young women. The procurement officer for the academy had ordered all of the women's undergarments from May Department Store, where she was a department manager. Motz wrote,

> I was friends with Diane, the Lingerie department manager. She told me that the academy had placed an order for underwear for the female cadets. I remember her telling me that the choice they ordered was not the best. The briefs were all cotton, which was appropriate, but in the 70s, a sports bra was not a popular choice. As I know the rigorous demands of the training, my friend and I had a conversation about whether she should go back to the procurement officer and suggest this type of bra. She took the advice, but was told that the budget dictated the original choice. I remember also that Diane and I felt sorry for the girls as the selection was not only unattractive, but not what was needed.

Personal e-mail communication with author, 26 Oct. 2004.

59. Huntoon interview, 6 June 2003.

60. Carolyn Huntoon, interview with Rebecca Wright, Barrington, RI, 5 June 2002.

61. Huntoon interview, 6 June 2003.

62. Ibid.

63. Ibid.

64. Ibid.

65. Ibid.

66. Ibid.

67. Sullivan interview, 19 Nov. 2002.

68. Huntoon interview, 6 June 2003.

69. Ibid.

70. Seddon interview, 12 Feb. 2003; Sullivan interview, 19 Nov. 2002.

71. Sullivan interview, 19 Nov. 2002.

72. Ibid.

73. Ibid.

74. "People," *Time*, 79.

75. Miskin, "In the New Astronaut Class," C-5.

76. Sullivan interview, 19 Nov. 2002.

77. Susan Okie, "What Makes Sally Ride?" *Florida Magazine*, 15 May 1983, Sally Ride (NASA Astronaut) file, NASA HQ; Thomas O'Toole, "Sally Ride Soars at Her First News Session," *Washington Post*, 25 May 1983, A5; Susan Okie, "Cool Hand Sally Showed the Right Stuff," *Washington Post*, 10 May 1983, A1.

CHAPTER 6: Defying Gravity

1. Donald T. Critchlow, *Phyllis Schlafly and Grassroots Conservatism: A Woman's Crusade* (Princeton: Princeton University Press, 2005), 1.

2. Christine L. Williams, Patti A. Giuffre, and Kirsten Dellinger, "Sexuality in the Workplace: Organizational Control, Sexual Harassment, and the Pursuit of Pleasure," *Annual Review of Sociology* 25 (1999): 73.

3. *The Presidential Commission on the Assignment of Women in the Armed Forces* (Washington, DC: U.S. Government Printing Office, 1992), 31–33.

4. NASA-STD-3000 Man-Systems Integration Standards, sec. 8.3.2.1, available online at http://msis.jsc.nasa.gov (accessed 29 Aug. 2010).

5. Allen J. Louviere to Mr. William D. Ray, 21 Jan. 1972, EW Reading file, Box 007-25, JSC.

6. Ibid.

7. NASA-STD-3000 Man-Systems Integration Standards, sec. 8.3.2.2–1, fig. 8.3.2.2–2.

8. Johnson to Louviere and Petynia, memorandum on Shuttle Orbiter Habitability Requirements, 8 Jan. 1973, Shuttle files, Box 007-55, JSC.

9. Ibid.

10. Leland F. Belew and Ernst Stulinger, *Skylab: A Guidebook* (Washington, DC: National Aeronautics and Space Administration, 1973), 62; John F. Kennedy Space Center (KSC), "NASA Facts: Life aboard the Space Shuttle," Jan. 1983 (KSC 337-82), U.S. Government Printing Office, 2.

11. E. P. Smith to Aaron Cohen, 17 June 1974, Shuttle files, Box 009-43, JSC.

12. KSC, "NASA Facts: Life aboard the Space Shuttle," Jan. 1983 (KSC 337-82), U.S. Government Printing Office, 7.

13. Kathy Sullivan, interview, 19 Nov. 2002.

14. "STS 41-G Flight Crew Report," 20 Dec. 1984, Vertical files, JSC.

15. Beth Dickey, "New Shuttle Problem: 'Nighties' for Crew," *Today*, 24 July 1980, 1B.

16. Ibid.

17. Kathy Sullivan, e-mail communication with author, 29 July 2004; Rhea Seddon, e-mail communication with author, 29 July 2004.

18. NASA-STD-3000 Man-Systems Integration Standards, sec. 11.13.1.3.1.

19. A crew systems branch manager did admit, however, that her supervisor encouraged her to start ordering undergarments for the women from JC Penney instead of Victoria's Secret, because the former would be an easier purchase to

explain when it appeared on the NASA credit card statement. Carolyn Krumrey, personal conversation with author, 2 July 2004.

20. "STS-8 Flight Crew Report," July 1984; "STS-9 Flight Crew Report," 8 June 1984; "STS 51-A Technical Crew Debriefing," Dec. 1984; "STS 51-G Technical Crew Debriefing," Aug. 1985; "STS 51-D Flightcrew Report," 17 Jan. 1986; "STS 61-B Technical Crew Debriefing," Jan. 1986, Vertical files, JSC.

21. "STS-8 Flight Crew Report," July 1984; "STS-9 Flight Crew Report," 8 June 1984, Vertical files, JSC.

22. NASA-STD-3000 Man-Systems Integration Standards, sec. 10.10.3, fig. 10.10.2–1.

23. Thomas O'Toole, "Sally Ride Soars at Her First News Session," *Washington Post*, 25 May 1983.

24. Sullivan interview, 19 Nov. 2002.

25. Ibid.

26. Ibid.

27. Ruth Winter, "Woman Astronaut? Not Very Soon: A Matter of Anatomy, Training," *San Diego Union*, 7 Mar. 1968, Women in Space file, NASA HQ.

28. NASA Headquarters, "Spacesuit Guidebook" (Washington, DC: National Aeronautics and Space Administration, 1991).

29. "Space Suits Smaller for Women," 29 Dec. 1978, Women in Space: 1978–90 file, NASA HQ.

30. James Schefter, "Space Chores Awaiting the Touch of Women," *Washington Star*, 26 Mar. 1981, A-5.

31. Thomas O'Toole, "Female Astronaut Walks in Space," *Washington Post*, 12 Oct. 1984, A6.

32. The Johnson Space Center website maintains a biographical sketch for every active and former NASA astronaut to include their flight activities, such as EVAs. See www.jsc.nasa.gov/Bios/astrobio.html (accessed 25 Aug. 2010).

33. Andrew Lawler, "NASA Decision Not Suited for Women," *Science* 295 (1 Mar. 2002): 1623.

34. K. C. Chhipwadia, personal conversation with author, Houston, TX, 2 July 2004; JSC Life Sciences Data Archive website, http://lsda.jsc.nasa.gov/lsda_home.cfm (accessed 16 Jan. 2011).

35. K. C. Chhipwadia, 2 July 2004; Alan M. Rochford, Oral History Project Transcript, interview with Summer Chick Bergen, Houston, TX, 15 Sept. 1998, 37. See www11.jsc.nasa.gov/history/oral_histories/oral_histories.htm.

36. NASA-STD-3000 Man-Systems Integration Standards, sec. 3.2.3.2.

37. Ibid., sec. 3.3.1.3; K. C. Chhipwadia, 2 July 2004.

38. K. C. Chhipwadia, 2 July 2004.

39. Carolyn Krumrey and K. C. Chhipwadia, personal conversations with author, Houston, TX, 2 July 2004.

40. "Space Toilet," 17 Aug. 1972, 14–17 Aug. 1972 file, Shuttle files, Box 007-43, JSC.

41. Ibid.

42. Memorandum from C. C. Johnson to Chief, Crew Systems Division, "Waste Management Fixture for Orbiter," 9 Mar. 1973, Shuttle files, Box 007-65, JSC.

43. Sally Ride, Sally Ride Science Festival event, George Mason University, Fairfax, VA, 24 Apr. 2004.

44. Charles Berry to Lt. Gen. Robert A. Patterson, Surgeon General, USAF, 16 Apr. 1973, Shuttle files, Box 008-14, JSC.

45. Charles Berry to Command Surgeon, Wright-Patterson AFB, "Request for Female Subjects to Support 0g Testing of Prototype Shuttle Waste Management System," 6 Apr. 1972, Shuttle files, Box 007-34, JSC.

46. Memorandum from Charles A. Berry to M. S. Malkin, "Proposed Shuttle 'White Paper,'" 28 Mar. 1974, Shuttle files, Box 009-22, JSC.

47. On flights when the astronauts were running experiments that required a large number of urine samples, the solution that the astronauts, engineers, and flight surgeons reached was to fly a piece of equipment called the urine monitoring system. The astronauts simply connected the urine hose from the toilet to the urine monitoring system. Rhea Seddon, phone interview with author, 27 July 2004.

48. K. C. Chhipwadia, 2 July 2004.

49. Rhea Seddon, phone interview with author, 27 July 2004.

50. Ibid.

51. Ibid.

52. Ibid.

53. Robert Godwin, ed., *Space Shuttle STS Flights 1–5: The NASA Mission Reports* (Burlington, ON: Apogee Books, 2001), 182.

54. Allen J. Louviere, Chief of Engineering Technology Branch, to William D. Ray, 21 Jan. 1972, Shuttle files, Box 007-25, JSC.

55. Lyndon B. Johnson Space Center, "STS-8 Flight Crew Report," July 1984, Vertical files, JSC.

56. Rhea Seddon, phone interview, 27 July 2004.

57. "STS-8 Flight Crew Report," JSC.

58. Ibid.

59. Joseph Kosmo, personal conversation with author, Houston, TX, 2 July 2004.

60. Rhea Seddon, e-mail communication with author, 26 July 2004.

61. Kosmo, personal conversation, 2 July 2004.

62. Amy Jo Ross and Joseph Kosmo, personal conversation, 2 July 2004.

63. Kosmo, personal conversation, 2 July 2004.

64. Terence Finn to Honorable Ron Paul, 13 Nov. 1979, Shuttle files, Box 019-11, JSC.

65. Joe Kosmo, phone interview with author, 9 Aug. 2004.

66. Dino Brugioni, *Eyeball to Eyeball: The Inside Story of the Cuban Missile Crisis* (New York: Random House, 1990), 183.

67. Rhea Seddon, phone interview, 27 July 2004.

68. Ibid.

69. Ibid.

70. Ibid.

71. Ibid.

72. Robert F. Thompson, Space Shuttle Program Manager, to NASA Headquarters, "Anthropometric Design Specifications to Accommodate Female Passengers in the Space Shuttle," 14 July 1975, Shuttle files, Box 011-36, JSC.

73. NASA-STD-3000 Man-Systems Integration Standards, sec. 8.6.3.1.

74. Anthony Potts, Jr., to NASA Administrator, 29 Jan. 1990, CA/CB Subject files, Astronaut Office-Flight Specific Originals folder, NARA-SW.

75. Memorandum from Donald Puddy, Flight Crew Operations Director, "Policy on Astronauts' Hair during Shuttle Missions," 7 Mar. 1990, CA/CB Subject files, Astronaut Office-Flight Specific Originals folder, NARA-SW.

CHAPTER 7: "NASA Sutra"

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Essay on Sources

Because this work tells the story of integrating women into the astronaut corps from multiple perspectives, the sources are equally varied. The majority of the book discusses some of the everyday tensions and issues that arose during selection, training, and the actual flights of the first female astronauts, making oral histories vital. Oral history interviews conducted with some of the first class of female astronauts, their male colleagues, and members of NASA management have been a key element of the research for this project. Astronauts Shannon Lucid, Rhea Seddon, and Kathy Sullivan were generous with their time and willingness to share their perspectives and experiences during their careers at NASA. In addition, the Johnson Space Center (JSC) Oral History Project has conducted interviews with JSC director Carolyn Huntoon, which were valuable in their own right, as well as helpful in preparing for specific discussions with her about the selection and the experiences of the Group VIII astronauts. Several human factors engineers at JSC generously gave their time and resources to this project. They introduced me to the NASA Standard 3000 volumes, which helped identify the factors and procedures involved in designing and maintaining the Space Shuttle and International Space Station for human occupation.

Finding archival material about the integration of women into NASA requires sifting through diverse collections. As an agency, NASA has kept good records of its activities related to equal employment opportunities in its various centers. Valuable documents that show how NASA was improving as a work environment for women and racial minorities generally exist in the NASA Headquarters History Office in Washington, D.C., in the NASA JSC archives at the University of Houston–Clear Lake, and in the George M. Low Papers housed at Rensselaer Polytechnic Institute in Troy, New York. Joseph D. Atkinson, Jr., and Jay M. Shafritz's book *The Real Stuff: A History of NASA's Astronaut Recruitment Program* (New York: Praeger, 1985) provided a compilation of data about each astronaut class, including selection criteria, through the selection of Group VIII.

In addition, NASA Headquarters and the center archives have an expanding collection on women in space. These files contained newspaper articles, transcripts, and correspondence dating from the women's attempts to join the astronaut corps in the 1960s through the Shuttle era. The History Office also maintains a biographical

file on each astronaut, containing news releases, articles, and photographs. The files for the first six women astronauts were enormously valuable. There are no biographies on or by the first six women astronauts, save a handful of children's books on Sally Ride; the children's book Ride wrote with Susan Okie, *To Space and Back* (New York: HarperCollins, 1986); and one children's book on Shannon Lucid. In fact, only two books address the history of women in the entire history of NASA: Laura S. Woodmansee's *Women of Space: Cool Careers on the Final Frontier* (Burlington, ON: Apogee Books, 2003) and Bettyann Holtzmann Kevles's *Almost Heaven: The Story of Women in Space* (New York: Basic Books, 2003). That makes the materials collected by the NASA HQ History Office and the oral history interviews all the more important. The JSC website posts biographies of the astronauts as well. These bios, while brief, highlight the flight experience of each astronaut, which made it possible to compile data on all the women astronauts selected since 1978.

The integration of women into the astronaut corps coincided with the design and construction of the Space Shuttle itself. Finding answers to the technical questions about how to design the Shuttle to accommodate women and mixed-sex crews meant sifting through documents related to the Shuttle design process. The George M. Low Papers contained correspondence about the new agenda for NASA leading into the Shuttle era, the Shuttle design, and the preparations for the selection of the first class of Shuttle astronauts. The collection included Administrator James Fletcher's speech in which the word "women" had been crossed out.

While not as compartmentalized with respect to women's history as NASA Headquarters, the JSC Archives at the University of Texas–Clear Lake housed technical documents and memoranda that influenced women in the program. The Shuttle files located there contained materials about the astronaut training program, management directives associated with the Astronaut Office, engineering correspondence, and flight crew reports. In all the files I have examined, I found the "chastity belt" schematic only in Houston. While the Smithsonian's National Air and Space Museum's Division of Space History has the actual drainage conduit in its collection, the entire workings would not have come together without that sketch.

The National Archives and Records Administration in Fort Worth, Texas, provided information about the astronauts' training and engineering work that was otherwise difficult to find.

Because cultural influences and social mores play a strong role in this story in terms of how people within NASA, as well as taxpayers, viewed the propriety of introducing women into the astronaut corps, the popular media—in particular, newspapers, science fiction literature, and film—offer a telling insight into what people thought at the time about women in space. The idea that women should or should not work as professionals in any given field represents a historic conflict in women's labor history.

As a way of examining the influence of science fiction on popular conceptions about women in space, it was important to examine works and writers who were significant to the science fiction genre but were also recognized outside its typical

readership. Focusing on authors such as Robert Heinlein, Arthur C. Clarke, and Ursula Le Guin, as well as popular comics and television shows such as *Buck Rogers* and *Star Trek*, ideally provides a cross-community representation.

The groundwork for this project required examining the history of women's opportunities in the workplace, particularly in the pipeline careers of aviation, science, engineering, and medicine. There is a growing body of literature on women in aviation and science, less so about women in engineering and medicine. Leslie Haynsworth and David M. Toomey's *Amelia Earhart's Daughters: The Wild and Glorious Story of American Women Aviators from World War II to the Dawn of the Space Age* (New York: Perennial, 2000) and Deborah Douglas's *American Women and Flight since 1940* (Lexington: University of Kentucky Press, 2004) provided a solid foundation in the history of women aviators in the second half of the twentieth century. Joseph Corn also discusses how women in the early twentieth century used aviation to create new opportunities and gain some semblance of equality in his book *The Winged Gospel: America's Romance with Aviation* (New York: Oxford University Press, 1983). Margaret Rossiter's two-volume series, *Women Scientists in America: Struggles and Strategies to 1940* (Baltimore: Johns Hopkins University Press, 1982) and *Women Scientists in America: Before Affirmative Action, 1940–1972* (Baltimore: Johns Hopkins University Press, 1995), represents the preeminent works on women in American science.

While Rossiter's work touches on the role of women in engineering, that subject remains an underrepresented field in the historiography. Information about women in engineering for this project has largely come from Natalie McIntire's *Curtis-Wright Cadettes: A Case Study of the Effect of the World War II Labor Shortage on Women in Engineering* (M.A. thesis, University of Minnesota, 1993); Amy Sue Bix's article "From 'Engineeresses' to 'Girl Engineers' to 'Good Engineers': A History of Women's U.S. Engineering Education," *NWSA Journal*, vol. 16, no. 1 (Spring 2004); Judith McIlwee and Gregg Robinson's *Women in Engineering: Gender, Power, and Workplace Culture* (Albany: State University of New York Press, 1992); Martha Moore Trescott's *New Images, New Paths: A History of Women in Engineering in the United States, 1850–1980* (Dallas: T&L Enterprises, 1996); and *Crossing Boundaries, Building Bridges: Comparing the History of Women Engineers, 1870s–1990s* (New York: Routledge, 2003), edited by Annie Canal, Ruth Oldenziel, and Karen Zachmann. Specific data about women who identify themselves as engineers were compiled from census data available through the Integrated Public Use Microdata Series (IPUMS-USA), managed by the Minnesota Population Center.

While this work deals with women who were selected as mission specialists, not as pilot-astronauts, explaining why women were not selected as pilots until 1990 requires an understanding of the role of women in the military, particularly their opportunities to fly high-performance aircraft. Several works grounded the discussion about women's opportunities in the military. Linda Bird Francke's book *Ground Zero: The Gender Wars in the Military* (New York: Simon and Schuster, 1997) draws on the history of women in the military from the Women's Armed Services Integra-

tion Act of 1948 through the revocation of the combat exclusion policies in the 1990s. Two articles, both addressing how exclusion from combat affected women in the military and both published around the passage of the 1991 Kennedy-Roth Amendment, which repealed the laws forbidding women from flying in combat, not only highlighted women's limited opportunities in the military but encapsulated the culture of the 1960s that kept many women out of pipeline careers. They were Marilyn Gordon and Mary Jo Ludvingson's "A Constitutional Analysis of the Combat Exclusion for Air Force Women," *Minerva*, vol. 9, no. 2 (Summer 1991); and Cynthia Enloe's "The Politics of Constructing the American Woman Soldier as a Professionalized 'First Class Citizen': Some Lessons from the Gulf War," *Minerva*, vol. 10, no. 1 (March 1992).

This work is more than just a history of technology; it also makes a contribution to gender and labor history. Understanding what changed—along with what still had to change—to make it possible for women to enter the astronaut corps requires some interpretation of the social expectations of women in the period leading up to the Group VIII selection. The works on gender that were most helpful were Elaine Tyler May's *Homeward Bound: American Families in the Cold War Era* (New York: Basic Books, 1988); *Not June Cleaver: Women and Gender in Postwar America, 1945–1960* (Philadelphia: Temple University Press, 1994), edited by Joanne Meyerowitz; Nancy Cott's *The Grounding of Modern Feminism* (New Haven: Yale University Press, 1987); and Linda Kerber's "Separate Spheres, Female Worlds, Woman's Place: The Rhetoric of Women's History," *Journal of American History*, vol. 71, no. 1 (June 1988). William Chafe's *The Unfinished Journey: America since World War II* (New York: Oxford University Press, 1984) captured the culture of the 1960s.

Since women's opportunities in pipeline careers were essential to their selection as astronauts, it was important to ground this project within a larger framework of women's labor history. The works most influential to that framework were Alice Kessler-Harris's *Out to Work: A History of Wage-Earning Women in the United States* (New York: Oxford University Press, 1982) and *In Pursuit of Equality: Women, Men, and the Quest for Economic Citizenship in 20th Century America* (New York: Oxford University Press, 2001); Sherna Berger Gluck's *Rosie the Riveter Revisited: Women, The War, and Social Change* (New York: Penguin Books, 1987); and the article "Women and the Paradox of Economic Inequality in the Twentieth-Century" by Michael B. Katz, Mark J. Stern, and Jamie J. Fader, published in the *Journal of Social History*, vol. 39, no. 1 (Fall 2005).

The FLATs' story has become better known over the last decade, thanks in part to a number of scholars and journalists working on their story. Recounting that story here is necessary only in terms of understanding why those women were unsuccessful in their pursuit of becoming astronauts in the 1960s and what changed in subsequent years to open opportunities for women in the 1970s. In addition to newspaper articles from the era and the Women in Space files at NASA Headquarters, Margaret Weitekamp's *Right Stuff, Wrong Sex: America's First Women in Space Program* (Baltimore: Johns Hopkins University Press, 2004) was essential. It ranks as

the most balanced book on the topic. Other works, such as Martha Ackmann's *The Mercury Thirteen: The Untold Story of Thirteen American Women and the Dream of Space Flight* (New York: Random House, 2003) and Stephanie Nolan's *Promised the Moon: The Untold Story of the First Women in the Space Race* (New York: Basic Books, 2004), offered additional interpretations.

Two of the greatest challenges facing NASA and the astronauts were changing attitudes about women as astronauts and equals and moving beyond peoples' concerns about sexuality and propriety. Several works facilitated a clearer understanding of sexual politics and the tenuous position NASA was in trying to navigate that road without ostracizing American taxpayers. Donald Critchlow's *Phyllis Schlafly and Grassroots Conservatism: A Woman's Crusade* (Princeton: Princeton University Press, 2005) describes the return to conservative values in the 1970s, particularly as they relate to women. Mark Byrnes's *Politics and Space: Image Making by NASA* (Westport, CT: Praeger, 1994) highlights NASA's identity as a federally funded agency and the limits that places on NASA's ability to push social agendas. Roger Launius's "A Western Mormon in Washington, D.C.: James C. Fletcher, NASA, and the Final Frontier," *Pacific Historical Review*, vol. 64, no. 2 (May 1995), emphasizes the conservative characteristics of NASA administrator James Fletcher during the 1970s that may have contributed to the agency's hesitance to push for a more progressive role for women in the astronaut corps and risk the public image of the entire program. The essay "Sexuality in the Workplace: Organizational Control, Sexual Harassment, and the Pursuit of Pleasure" by Christine L. Williams, Patti A. Guiffre, and Kirsten Dellinger, which appeared in *Annual Review of Sociology*, vol. 25 (1999), discusses the propensity of sexual harassment and sexual relationships in the workplace. Finally, Alison Weir's *Sacrificial Logics: Feminist Theory and the Critique of Identity* (New York: Routledge, 1996) was irreplaceable when it came to constructing a final analysis of NASA's effectiveness with regard to the integration of women into the astronaut corps.

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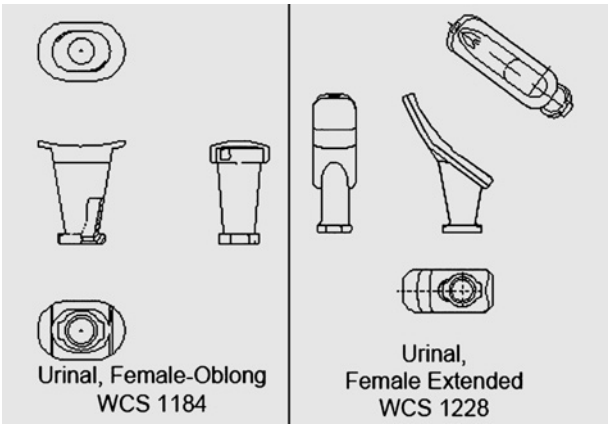
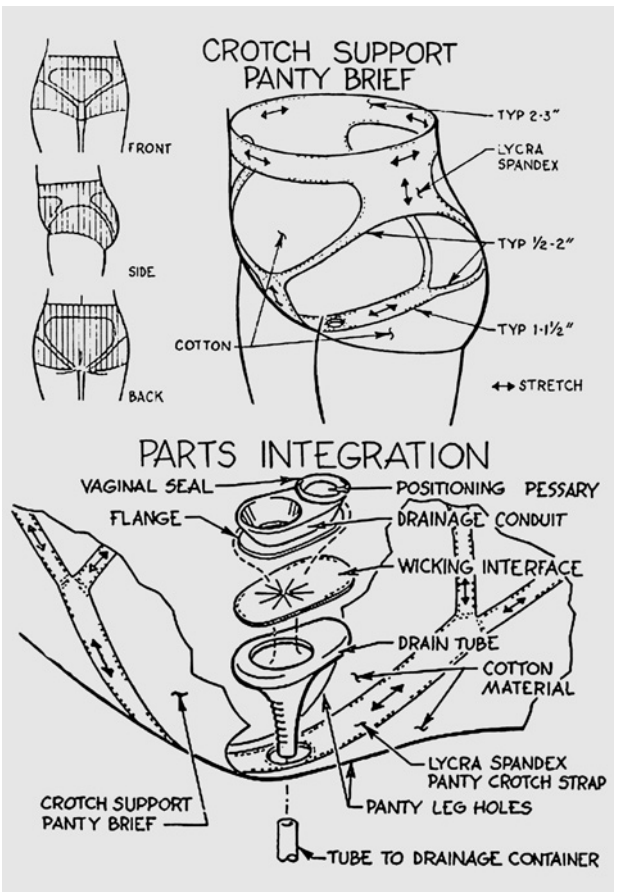
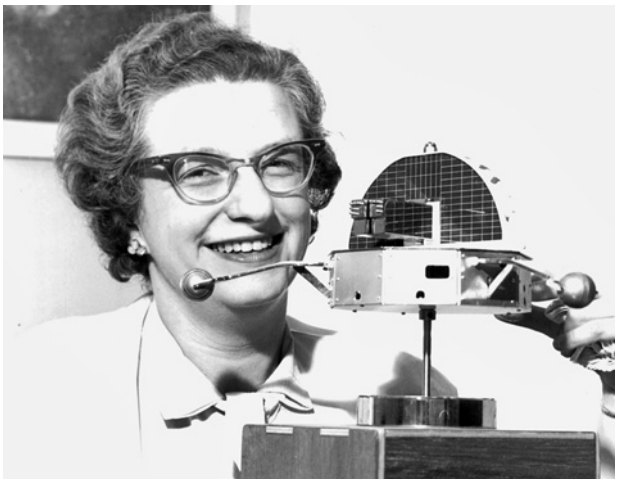


Female Urinal Funnels. NASA engineers designed these funnels for women astronauts to use aboard the Space Shuttle. The funnels attached to the Space Shuttle toilet's urine collection tube and allowed the women astronauts to use the toilet with minimal clean-up. NASA, Johnson Space Center.



Crotch Support Panty Brief. An early design for a female urine collection device for use during launch, landing, and spacewalks. Since the launch of Gus Grissom in July 1961, male astronauts have used an external sheath attached to a collection bag, but that system did not work for women astronauts. This design attempted to mimic the external collection system used by the men. Although the women astronauts experimented with this system initially, NASA human factors engineers settled on a diaper. "Women in Space," 1974–1979, Box 18, Poindexter Files, Center Series. Johnson Space Center History Collection, University of Houston–Clear Lake.



Dr. Nancy Roman.
Dr. Nancy Grace Roman joined NASA in 1959 and became the chief of the astronomy and relativity program in 1960. Dr. Roman represented one of the earliest success stories for women at NASA and inspired girls and young women to enter the sciences. NASA Headquarters, GPN-2002-000212.

First Class of Women Astronauts.
Selected in 1978 as part of Group VIII, six women joined NASA's astronaut corps. *Left to right,* Shannon W. Lucid, Margaret Rhea Seddon, Kathryn D. Sullivan, Judith A. Resnik, Anna L. Fisher, and Sally K. Ride. NASA Headquarters, GPN-2004-00025.

Kathryn Sullivan Sets Altitude Record.
In 1979, while still an Astronaut Candidate, Kathryn Sullivan set an unofficial sustained altitude record for American women by flying in a NASA WB-57F reconnaissance aircraft with NASA research pilot Jim Korkowski to an altitude of 63,300 feet. NASA Headquarters, GPN-2002-000199.

First Six Women Astronauts with "Rescue Ball."
Taken in 1980, the first six women astronauts pose with the "rescue ball," a personal rescue enclosure designed for use by the astronauts in case of emergency. By 1980, the Group VIII astronaut candidates had completed their training and were awaiting flight assignments. NASA Headquarters, GPN-2002-000207.

First Female Astronaut Candidates.
Five of the six women astronaut candidates during their water survival training at Homestead Air Force Base, Florida. Within the astronaut class of thirty-five people, the six women functioned as an internal group, discussing best practices, knowing that their efforts set precedents and expectations for women astronauts to follow. NASA Headquarters, GPN-2002-000214.

Ride on the Flight Deck.
Sally K. Ride became the first American woman to fly in space on STS-7. Launched on June 18, 1983, *Challenger*'s five-person crew completed a six-day mission, delivering two communication satellites into orbit. NASA Headquarters, GPN-2000-001083.

Sullivan and Ride Show Sleep Restraint.
Astronauts Kathryn Sullivan and Sally Ride *(left to right)* show a sleep restraint system, known as "a bag of worms." The restraint consists of clasps, bungee cords and Velcro strips that allow the astronaut to attach herself or himself to a bulkhead wall to keep from free-floating through the cabin. This flight of *Challenger*, STS-41G, marked the first time two women astronauts flew together, the first time an American woman flew in space twice, and the first time a woman astronaut (Sullivan) performed a spacewalk. *Challenger* launched on October 5, 1984 and returned to Kennedy Space Center on October 13, after eight days in orbit. NASA Headquarters, GPN-2000-001032.

Kathy Sullivan Dons her Suit.
On STS-31, the crew of Space Shuttle *Discovery* launched the Hubble Space Telescope. Now-veteran spacewalker Kathy Sullivan trained to conduct an EVA (extravehicular activity) in case problems developed during the deployment. Sullivan was the only woman among the Group VIII astronauts to conduct a spacewalk. NASA Headquarters, GPN-2006-000014.

STS-41D Crew Enjoying Space.
Judith Resnik became the second American woman to fly in space aboard *Discovery*'s flight of STS-41D, which launched on August 30, 1984. Crewmembers are (*counter-clockwise from top left*) payload specialist Charles D. Walker, mission specialist Richard M. Mullane, crew commander Henry W. Harsfield, Jr., pilot Michael L. Coats, mission specialist Steven A. Hawley, and mission specialist Resnik. The flight of STS-41D was cut short by a day when the toilet shut down prematurely, mostly affecting Resnik since the male crew members were able to work around the failure using excess plastic bags and dirty socks as an absorbent material. NASA Headquarters, GPN-2004-00024.

Lucid on Treadmill in Russian *Mir*.
At 53 years old, Shannon Lucid spent 6 months aboard the Russian Space Station *Mir* in 1996, setting the duration record for a woman, 188 days. She spent 2 hours a day on the treadmill to make sure she would have the muscle strength to walk off the Shuttle under her own power when she returned to earth. As the oldest woman in the class of 1978, her success as an astronaut has been viewed as "heroic" to both women and the Baby Boomer generation. NASA Headquarters, GPN-2000-001034.